

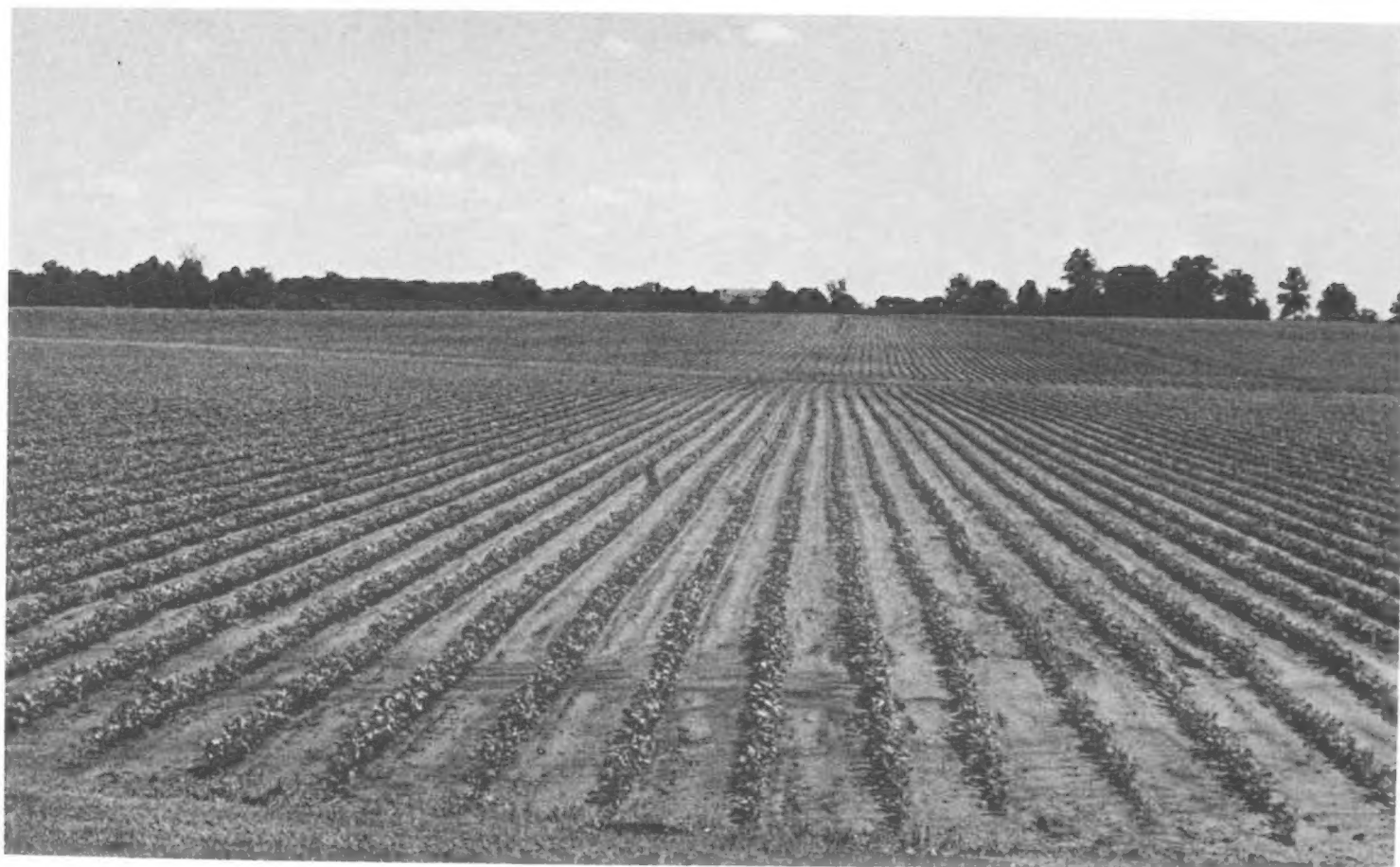


United States  
Department of  
Agriculture

Soil  
Conservation  
Service

In cooperation with  
Missouri Agricultural  
Experiment Station

# Soil Survey of Marion and Ralls Counties Missouri



# How To Use This Soil Survey

## General Soil Map

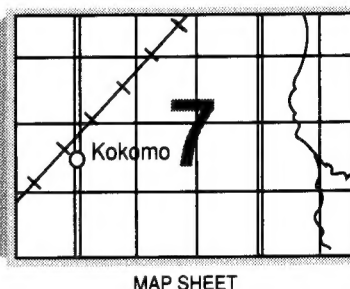
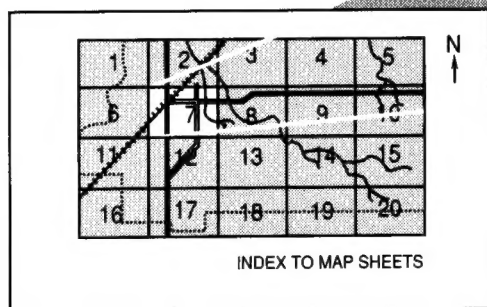
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

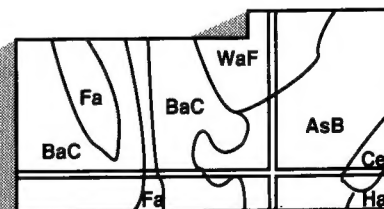
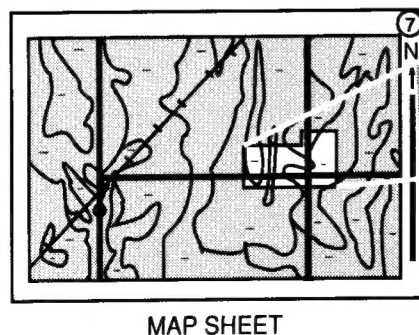
## Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

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This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made by the Soil Conservation Service in cooperation with the Missouri Agricultural Experiment Station. Soil scientists from the Missouri Department of Natural Resources assisted with the fieldwork. This survey is part of the technical assistance furnished to the Marion and Ralls Counties Soil and Water Conservation Districts. Major fieldwork for this soil survey was completed in 1981. Soil names and descriptions were approved in 1981. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1981.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

This soil survey supersedes the soil surveys of Marion and Ralls Counties published in 1911 and 1914, respectively.

**Cover: Soybeans on Smileyville silt loam, 2 to 6 percent slopes. Most of the soils in Marion and Ralls Counties are suitable for sustained crop production.**

# Contents

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<b>Index to map units</b> .....	iv	Windbreaks and environmental plantings.....	41
<b>Summary of tables</b> .....	v	Recreation .....	41
<b>Foreword</b> .....	vii	Wildlife habitat .....	42
General nature of the survey area .....	1	Engineering .....	44
How this survey was made .....	2	<b>Soil properties</b> .....	49
Map unit composition.....	3	Engineering index properties.....	49
<b>General soil map units</b> .....	5	Physical and chemical properties.....	50
Soil descriptions .....	5	Soil and water features.....	51
<b>Detailed soil map units</b> .....	13	<b>Classification of the soils</b> .....	53
Soil descriptions .....	13	Soil series and their morphology.....	53
<b>Prime farmland</b> .....	35	<b>Formation of the soils</b> .....	69
<b>Use and management of the soils</b> .....	37	<b>References</b> .....	73
Crops and pasture.....	37	<b>Glossary</b> .....	75
Woodland management and productivity.....	39	<b>Tables</b> .....	83

## Soil Series

Armstrong series .....	53	Goss series .....	60
Belknap series .....	54	Landes series.....	61
Blackoar series .....	54	Leonard series.....	61
Blase series.....	55	Lindley series.....	62
Calwoods series .....	55	Marion series .....	62
Carlow series .....	56	Menfro series.....	63
Cedargap series .....	56	Mexico series.....	63
Chariton series.....	57	Moniteau series .....	64
Chequest series.....	57	Putnam series .....	64
Edina series .....	58	Sampsel series .....	65
Fatima series .....	58	Smileyville series .....	65
Gifford series .....	59	Vigar series .....	66
Gorin series.....	59	Weller series .....	66
Gosport series .....	60	Winfield series .....	67

Issued September 1984



# Index to Map Units

---

2C2—Armstrong loam, 5 to 9 percent slopes, eroded .....	13	21F—Lindley loam, 20 to 35 percent slopes.....	24
2D2—Armstrong loam, 9 to 14 percent slopes, eroded .....	14	22B—Marion silt loam, 2 to 5 percent slopes .....	25
4—Belknap silt loam .....	14	23B—Menfro silt loam, 2 to 5 percent slopes.....	26
5—Blackoar silt loam .....	15	23C2—Menfro silt loam, 5 to 9 percent slopes, eroded .....	26
6—Blase silty clay .....	15	23D2—Menfro silt loam, 9 to 14 percent slopes, eroded .....	27
7B—Calwoods silt loam, 2 to 5 percent slopes .....	16	23E—Menfro silt loam, 14 to 20 percent slopes.....	27
8—Carlow silty clay .....	16	23F—Menfro silt loam, 20 to 35 percent slopes.....	28
9—Cedargap silt loam .....	17	24B2—Mexico silty clay loam, 2 to 5 percent slopes, eroded .....	28
10—Chariton silt loam .....	17	25—Moniteau silt loam .....	29
11—Chequest silty clay loam .....	18	26—Putnam silt loam.....	29
12—Edina silt loam .....	19	27C—Sampsel silty clay loam, 5 to 9 percent slopes	30
13—Fatima silt loam .....	19	27D—Sampsel silty clay loam, 9 to 14 percent slopes.....	31
14B—Gifford silt loam, 2 to 5 percent slopes .....	19	28B—Smileyville silt loam, 2 to 6 percent slopes.....	31
14C—Gifford silt loam, 5 to 9 percent slopes .....	20	29B—Vigar loam, 2 to 5 percent slopes .....	32
15C—Gorin silt loam, 5 to 9 percent slopes.....	21	30B—Weller silt loam, 2 to 5 percent slopes .....	32
16D—Gosport silty clay loam, 9 to 14 percent slopes.....	21	31C2—Winfield silt loam, 5 to 9 percent slopes, eroded .....	33
16E—Gosport silty clay loam, 14 to 20 percent slopes.....	22	31D2—Winfield silt loam, 9 to 14 percent slopes, eroded .....	34
17F—Goss cherty silt loam, 15 to 30 percent slopes	23	32—Pits-Orthents complex .....	34
19—Landes fine sandy loam .....	23		
20C—Leonard silt loam, 5 to 9 percent slopes.....	23		
21E—Lindley loam, 14 to 20 percent slopes.....	24		

# Summary of Tables

---

Temperature and precipitation (table 1).....	84
Freeze dates in spring and fall (table 2).....	85
<i>Probability. Temperature.</i>	
Growing season (table 3).....	85
Acreage and proportionate extent of the soils (table 4).....	86
<i>Marion County. Ralls County. Total—Area, Extent.</i>	
Capability and yields per acre of crops and pasture (table 5).....	87
<i>Capability subclass. Corn. Soybeans. Grain sorghum.</i>	
<i>Winter wheat. Grass-legume hay. Tall fescue.</i>	
Woodland management and productivity (table 6).....	89
<i>Ordination symbol. Management concerns. Potential</i>	
<i>productivity. Trees to plant.</i>	
Windbreaks and environmental plantings (table 7).....	91
Recreational development (table 8).....	95
<i>Camp areas. Picnic areas. Playgrounds. Paths and trails.</i>	
<i>Golf fairways.</i>	
Wildlife habitat (table 9).....	98
<i>Potential for habitat elements. Potential as habitat for—</i>	
<i>Openland wildlife, Woodland wildlife, Wetland wildlife.</i>	
Building site development (table 10).....	100
<i>Shallow excavations. Dwellings without basements.</i>	
<i>Dwellings with basements. Small commercial buildings.</i>	
<i>Local roads and streets. Lawns and landscaping.</i>	
Sanitary facilities (table 11).....	103
<i>Septic tank absorption fields. Sewage lagoon areas.</i>	
<i>Trench sanitary landfill. Area sanitary landfill. Daily cover</i>	
<i>for landfill.</i>	
Construction materials (table 12).....	106
<i>Roadfill. Sand. Gravel. Topsoil.</i>	
Water management (table 13).....	108
<i>Limitations for—Pond reservoir areas; Embankments,</i>	
<i>dikes, and levees. Features affecting—Drainage, Irrigation,</i>	
<i>Terraces and diversions, Grassed waterways.</i>	
Engineering index properties (table 14).....	110
<i>Depth. USDA texture. Classification—Unified, AASHTO.</i>	
<i>Fragments greater than 3 inches. Percentage passing</i>	
<i>sieve number—4, 10, 40, 200. Liquid limit. Plasticity index.</i>	

---

Physical and chemical properties of the soils (table 15) .....	113
<i>Depth. Clay. Moist bulk density. Permeability. Available water capacity. Soil reaction. Salinity. Shrink-swell potential. Erosion factors. Wind erodibility group. Organic matter.</i>	
Soil and water features (table 16).....	115
<i>Hydrologic group. Flooding. High water table. Bedrock. Potential frost action. Risk of corrosion.</i>	
Classification of the soils (table 17).....	117
<i>Family or higher taxonomic class.</i>	

# Foreword

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This soil survey contains information that can be used in land-planning programs in Marion and Ralls Counties. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

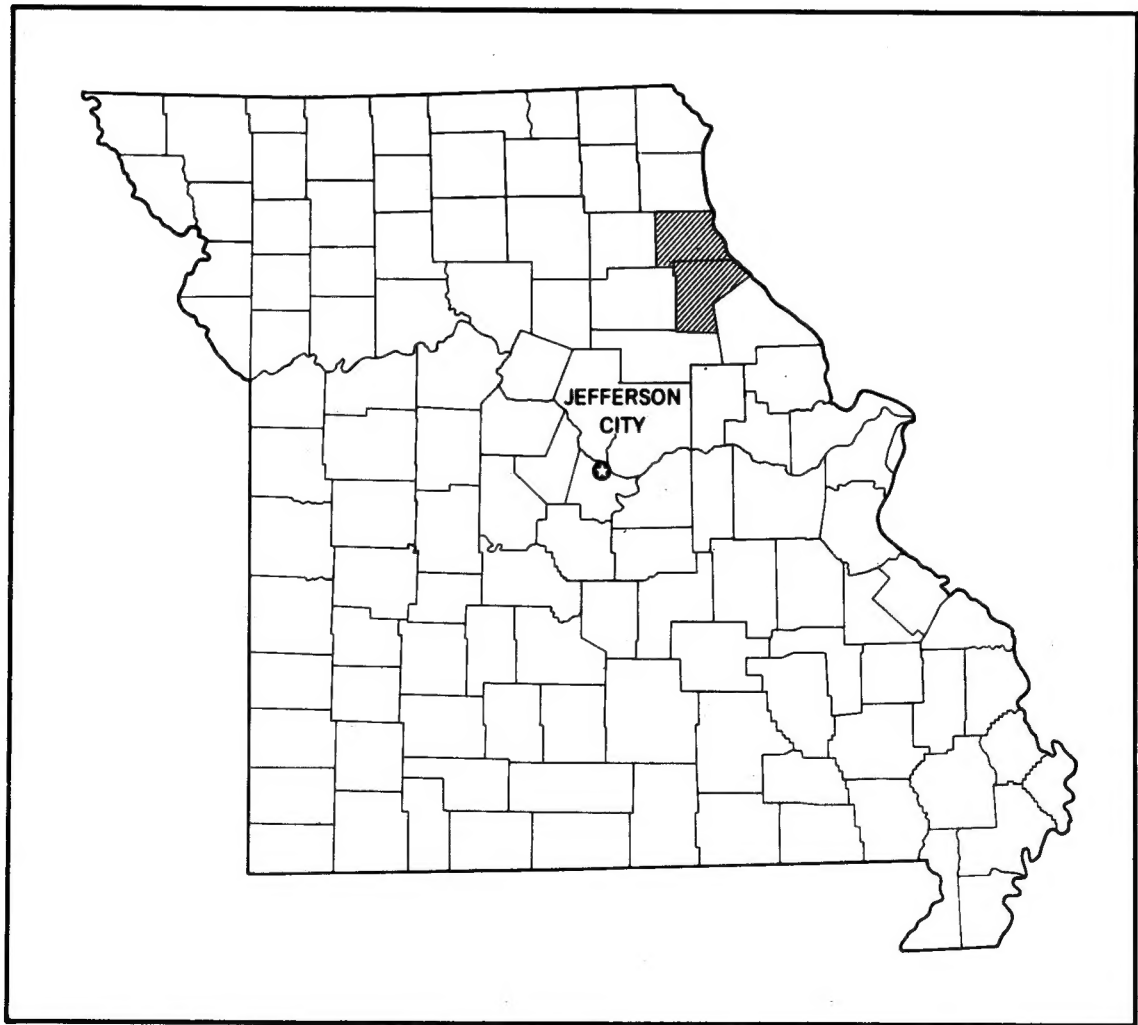
This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.



Paul F. Larson  
State Conservationist  
Soil Conservation Service



**Location of Marion and Ralls Counties in Missouri.**

# Soil Survey of Marion and Ralls Counties, Missouri

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By F. Conrad Watson, Soil Conservation Service

Fieldwork by F. Conrad Watson, party leader, and Carol A. Bartles, Les Tobin, and James E. Yarbrough, Soil Conservation Service, and Gary M. Noel and Earl W. Pabst, Missouri Department of Natural Resources

United States Department of Agriculture, Soil Conservation Service  
In cooperation with the Missouri Agricultural Experiment Station

Marion and Ralls Counties are in the northeastern part of Missouri. Both counties border the Mississippi River. They cover approximately 928 square miles, or 593,933 acres. In 1980, according to the census, the population of Marion County was 28,638, and the population of Ralls County was 8,911.

There are numerous businesses and industries in and around Hannibal, the largest town in the two-county area. Farming, however, is the most important enterprise in the counties. Farming is diversified. It consists mainly of growing row crops and raising hogs and beef cattle. A few farms have dairy herds. The soils on the flood plains of the Mississippi River and the Salt River are used almost exclusively for corn and soybeans. A smaller acreage is used for wheat.

Large quantities of the grain grown in the area are shipped by barge on the Mississippi River from a grain terminal in Hannibal.

## General Nature of the Survey Area

This section gives general information about the survey area. It discusses climate, natural resources, relief and drainage, settlement, and transportation and industry.

## Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

The climate in the survey area is characterized by cold winters and long, hot summers. Heavy rains occur mainly in spring and early in summer. The annual rainfall normally is adequate for corn, soybeans, and all grains.

Occasionally, there are tornadoes and severe thunderstorms, but these are local and of short duration. Damage varies. Hailstorms occur during the warmer part of the year in an irregular pattern and only in small areas.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Hannibal, Missouri, in the period 1951 to 1979. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 28 degrees F, and the average daily minimum temperature is 20 degrees. The lowest temperature on record, which occurred at Hannibal on January 17, 1977, is -18 degrees. In summer the average temperature is 74 degrees, and the average daily maximum temperature is 85 degrees. The highest recorded temperature, which occurred at Hannibal on July 14, 1954, is 114 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 38 inches. Of this, 23 inches, or 60 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 18 inches. The heaviest 1-day rainfall during the period of record was 4.54 inches at Hannibal on October 12, 1969. Thunderstorms occur on about 45 days each year, and most occur in summer.

The average seasonal snowfall is 27 inches. The greatest snow depth at any one time during the period of record was 19 inches. On an average of 20 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 85 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 12 miles per hour, in spring.

## Natural Resources

Soil is the most important resource in the survey area. Many products are derived from the soil; crops, livestock, wood, fruits, vegetables, and honey are all produced on farms and are marketable items. Also, the thick soil cover is suited to many kinds of construction, and sand and gravel are available.

Mineral resources include limestone, coal, shale, and structural clay. Coal was mined in Ralls County until 1962. In 1982, coal mining resumed.

## Relief and Drainage

Marion and Ralls Counties are composed of several major physiographic regions. The eastern part of Marion County and northeastern part of Ralls County are on the Mississippi River flood plain. Loess-covered hills, underlain by cherty limestone and shale, border the flood plain. The western part of the survey area is a prairie in a region of loess and glacial till.

Elevation ranges from about 450 feet above sea level along the Mississippi River on the southern edge of Ralls County to about 770 feet in the east-central part of the survey area.

All of the survey area drains into the Mississippi River or into its tributaries.

## Settlement

The area that became Marion and Ralls Counties was settled early and developed quickly because the Mississippi River provided easy access to the area. Ralls County was formed in 1820 and included what is now Marion County. In 1825 and 1836, Marion and Ralls Counties were formed as they exist today.

Farming quickly became the main economic base in the survey area. Many small settlements grew, prospered, and gradually disappeared.

In Marion and Ralls Counties there are many old houses that are well preserved. The "old section" of Hannibal contains many restored houses, stores, and shops. The boyhood home of Samuel Clemens (Mark Twain) is in the historic district of Hannibal and is a popular, well preserved tourist attraction.

Hannibal has the largest population in the survey area. The county seats, Palmyra and New London, are the next largest communities.

## Transportation and Industry

Numerous state and federal highways traverse the survey area. Almost every rural road is graveled, and private roads commonly are graveled. The survey area is served by two railroad lines and two county airfields. Barges transport many goods up and down the Mississippi River.

There are many industrial operations in the survey area that provide goods and services and employ more than 2,700 workers. The principal products are agricultural chemicals, cement, heating elements, shoes and boots, optical lenses, fiberglass products, packaged meat spreads, and seat belts. A small percentage of the labor force works in the Quincy area.

## How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship,



are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area, and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads,

and rivers, all of which help in locating boundaries accurately.

This soil survey supersedes the soil surveys of Marion and Ralls Counties published in 1911 and 1914, respectively (6, 7). This survey provides additional information about the soils and has larger maps that show the soils in greater detail.

## Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.



# General Soil Map Units

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The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit or association on the general soil map is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in other associations but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Some of the boundaries on the soil maps of Marion and Ralls Counties do not match those on the soil maps of adjacent counties, and some of the soil names and descriptions do not fully agree. The differences are a result of improvements in the classification of soils, particularly modification or refinements in soil series concepts. Also, there may be differences in the intensity of mapping or in the extent of the soils within the survey area.

## Soil Descriptions

### 1. Putnam-Mexico Association

*Nearly level and gently sloping, poorly drained and somewhat poorly drained soils that formed in loess; on uplands*

The soils in this association are on broad upland divides that have long side slopes and narrow, branching drainageways (fig. 1). The slopes range from 0 to 5 percent.

This association makes up about 20 percent of Marion County and 30 percent of Ralls County. It is about 51 percent Putnam soils, 46 percent Mexico soils, and 3 percent minor soils.

Putnam soils are nearly level and are on the highest part of the landscape. They are poorly drained. Typically, they have a very dark grayish brown silt loam surface layer and a gray silt loam subsurface layer. The upper part of the subsoil is dark gray, mottled silty clay, and the

lower part is grayish brown, mottled silty clay. The substratum is gray, mottled silty clay loam.

Mexico soils are gently sloping and are on concave side slopes. They are somewhat poorly drained. Typically, they have a very dark grayish brown silty clay loam surface layer. The upper part of the subsoil is dark grayish brown, mottled silty clay; the middle part is grayish brown and gray, mottled silty clay; and the lower part is grayish brown, mottled silty clay loam. The substratum is gray, mottled silty clay loam.

The minor soils in this association are the moderately well drained, moderately sloping Armstrong soils, which are on the lower part of side slopes.

In most areas, the soils in this association are used for corn, soybeans, or wheat. In some areas they are used for hay and pasture.

If the soils are used for crops, controlling water erosion and maintaining or improving fertility and tilth are the main management concerns on the gently sloping soils. Conservation tillage, grassed waterways, terraces, and contour farming help control erosion. Wetness is the main concern on the nearly level soils and may affect tilling and harvesting in spring and fall.

The soils are suited to pasture. Erosion caused by overgrazing is a major concern on the sloping soils. Wetness is a concern on the nearly level soils.

The soils are suitable for building site development and for some types of sanitary facilities. The high shrink-swell potential of the clayey subsoil, wetness, and low strength are the main limitations for building site development. Sewage lagoons commonly work satisfactorily on the nearly level soils.

### 2. Armstrong-Leonard Association

*Moderately sloping and strongly sloping, moderately well drained and poorly drained soils that formed in glacial till, loess, and pedisegment; on uplands*

The soils in this association are on ridgetops and side slopes and at the head of drainageways (fig. 2). The slopes are short and are dissected by drainageways. The slopes range from 5 to 14 percent.

This association makes up about 18 percent of Marion County and 18 percent of Ralls County. It is about 52 percent Armstrong soils, 26 percent Leonard soils, and 22 percent minor soils.

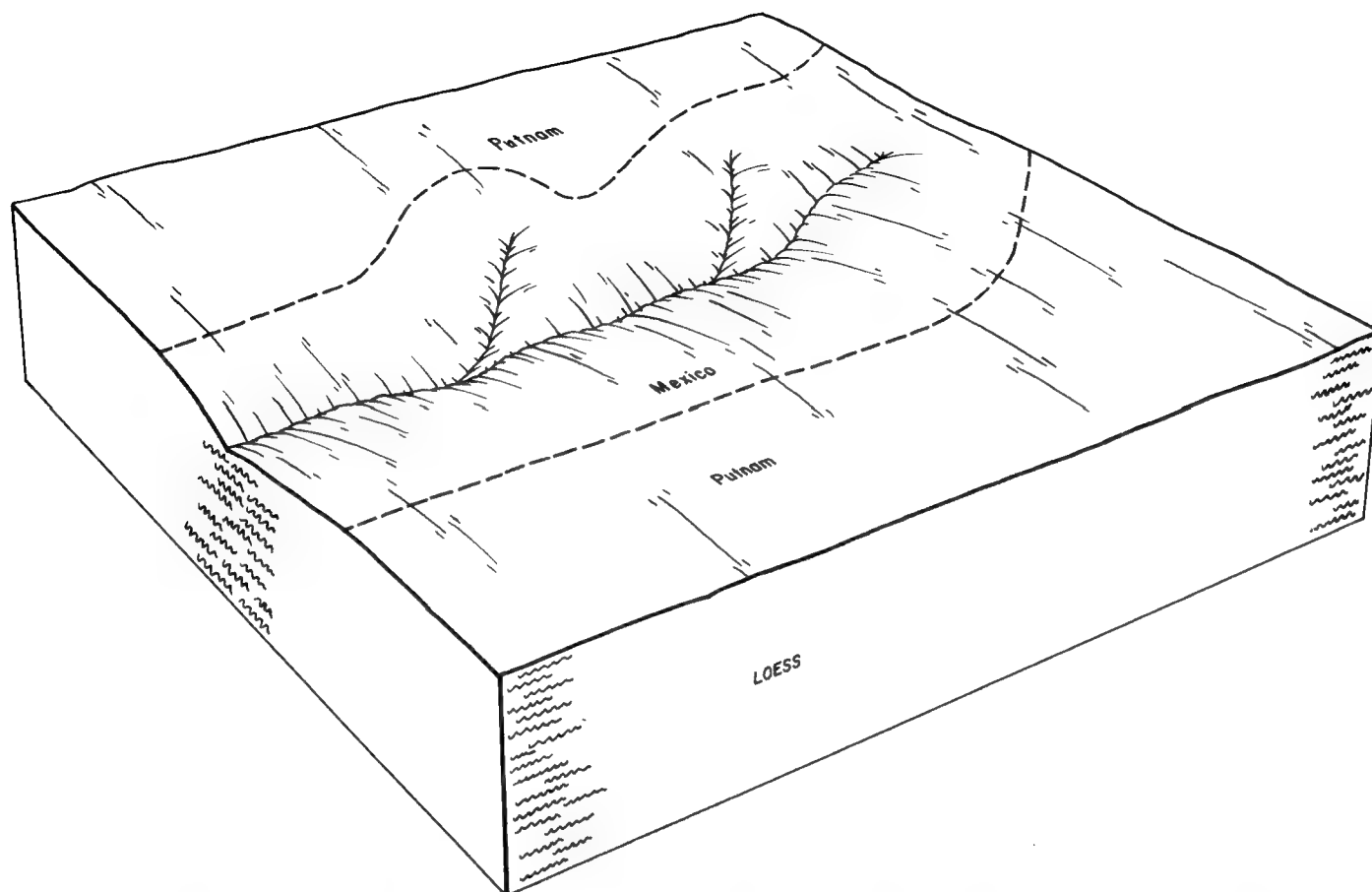


Figure 1.—Typical pattern of soils and parent material in the Putnam-Mexico association.

Armstrong soils are moderately sloping and strongly sloping. They are moderately well drained and formed in glacial till. Typically, they have a very dark grayish brown loam surface layer. The upper part of the subsoil is dark brown, mottled clay loam, and the lower part is strong brown, mottled clay loam.

Leonard soils are moderately sloping. They are poorly drained and formed in loess and pedisement. Typically, they have a very dark grayish brown silt loam surface layer. The upper part of the subsoil is dark grayish brown, mottled silty clay loam, and the lower part is dark grayish brown, gray, grayish brown, and light brownish gray, mottled silty clay.

The minor soils in this association are the well drained, moderately steep Lindley soils and the well drained, steep, cherty Goss soils. These soils are on narrow ridgetops and steep side slopes and commonly are in positions lower than those of the Armstrong and Leonard soils.

In about 60 percent of the areas, the soils in this association are used for corn, soybeans, or wheat. In the rest of the areas, the soils are in pasture, hay, or trees.

On cropland, controlling water erosion and maintaining or improving fertility and tilth are the main concerns in

management. Conservation tillage, winter cover crops, terraces, and grassed waterways help control erosion. In the moderately sloping areas, the slopes are too short to be farmed on the contour. In the strongly sloping areas, the slopes are too steep to be terraced.

Erosion caused by overgrazing is a major concern in pasture management. The soils are suited to trees; however, the only wooded areas are those that are too steep or too uneven to be cultivated. Oak and hickory are the dominant species.

The soils are suitable for building site development and for some types of sanitary facilities. Slow permeability, slope, wetness, the high shrink-swell potential of the subsoil, and low strength are the major limitations.

### 3. Goss-Gorin-Lindley Association

*Moderately sloping to steep, well drained to somewhat poorly drained soils that formed in cherty limestone residuum, loess, glacial sediment, and glacial till; on uplands*

The soils in this association are on narrow ridgetops, side slopes, and in deep, narrow valleys that are commonly less than one-eighth mile wide (fig. 3). The slopes range from 5 to 35 percent.

This association makes up about 16 percent of Marion County and 12 percent of Ralls County. It is about 54 percent Goss soils, 23 percent Gorin soils, 12 percent Lindley soils, and 11 percent minor soils.

Goss soils are moderately steep and steep. They are on narrow ridgetops and on side slopes. They are well drained and formed in residuum of cherty limestone. Typically, they have a very dark grayish brown cherty silt loam surface layer. The subsoil is cherty silty clay. The upper part is reddish brown, the middle part is yellowish red, and the lower part is yellowish brown.

Gorin soils are moderately sloping and are on ridgetops above the Lindley soils. Gorin soils are somewhat poorly drained and formed in loess and glacial sediment. The surface layer is very dark grayish brown silt loam, and the subsurface layer is brown silt loam. The upper part of the subsoil is dark yellowish brown silty clay loam; the middle part is dark brown and grayish brown, mottled silty clay; and the lower part is grayish brown, mottled silty clay loam.

Lindley soils are moderately steep and steep. They are on side slopes upslope from the Goss soils and on narrow ridgetops. They are moderately well drained and formed in glacial till. The surface layer is very dark grayish brown loam, and the subsurface layer is dark grayish brown loam. The subsoil and substratum are

yellowish brown clay loam. The subsoil is mottled in the lower part.

The minor soils in this association are the well drained, nearly level Cedargap soils; the moderately well drained, moderately sloping and strongly sloping Armstrong soils; the somewhat poorly drained, gently sloping Calwoods soils; and the moderately well drained, strongly sloping and moderately steep Gosport soils. Cedargap soils are on narrow bottom lands. Armstrong and Calwoods soils are on narrow ridgetops and on side slopes in positions higher than those of the Goss and Lindley soils. Gosport soils are in positions similar to those of the Goss soils.

In about 70 percent of the areas, the soils in this association are in native hardwood forest, which consists predominantly of oak and hickory. The cleared areas, which are mainly on ridgetops and on the upper part of side slopes, are in pasture. The less sloping areas, most of which are cleared, are suitable for pasture. Slope and the hazard of erosion are the main concerns.

The wooded areas generally are too steep or too cherty to be cleared. Improving timber stands is necessary to obtain the best production. Steepness of slope restricts the use of logging equipment.

The soils in this association are suited to some types of sanitary facilities and to building site development. Slow permeability, slope, large stones, and the moderate

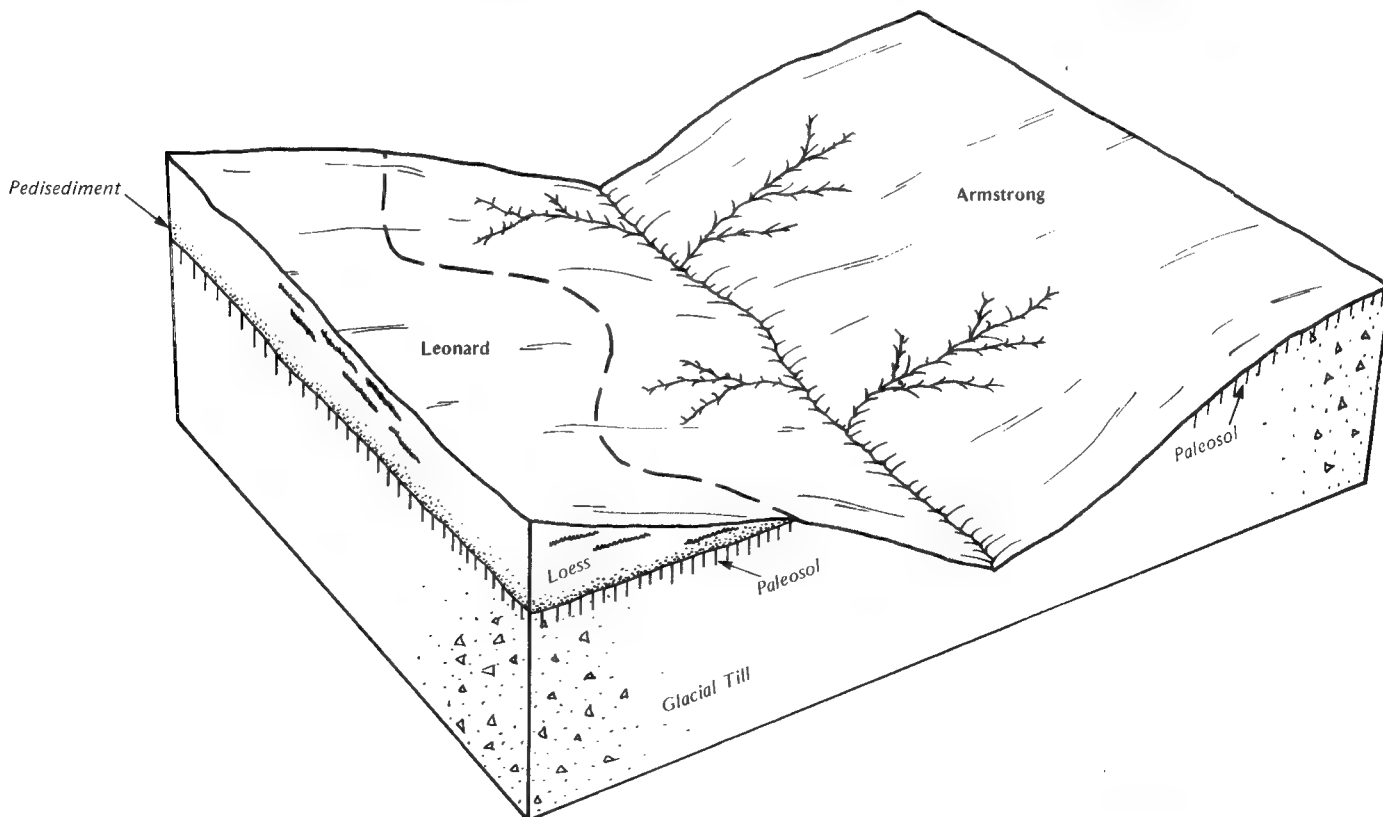


Figure 2.—Typical pattern of soils and parent material in the Armstrong-Leonard association.

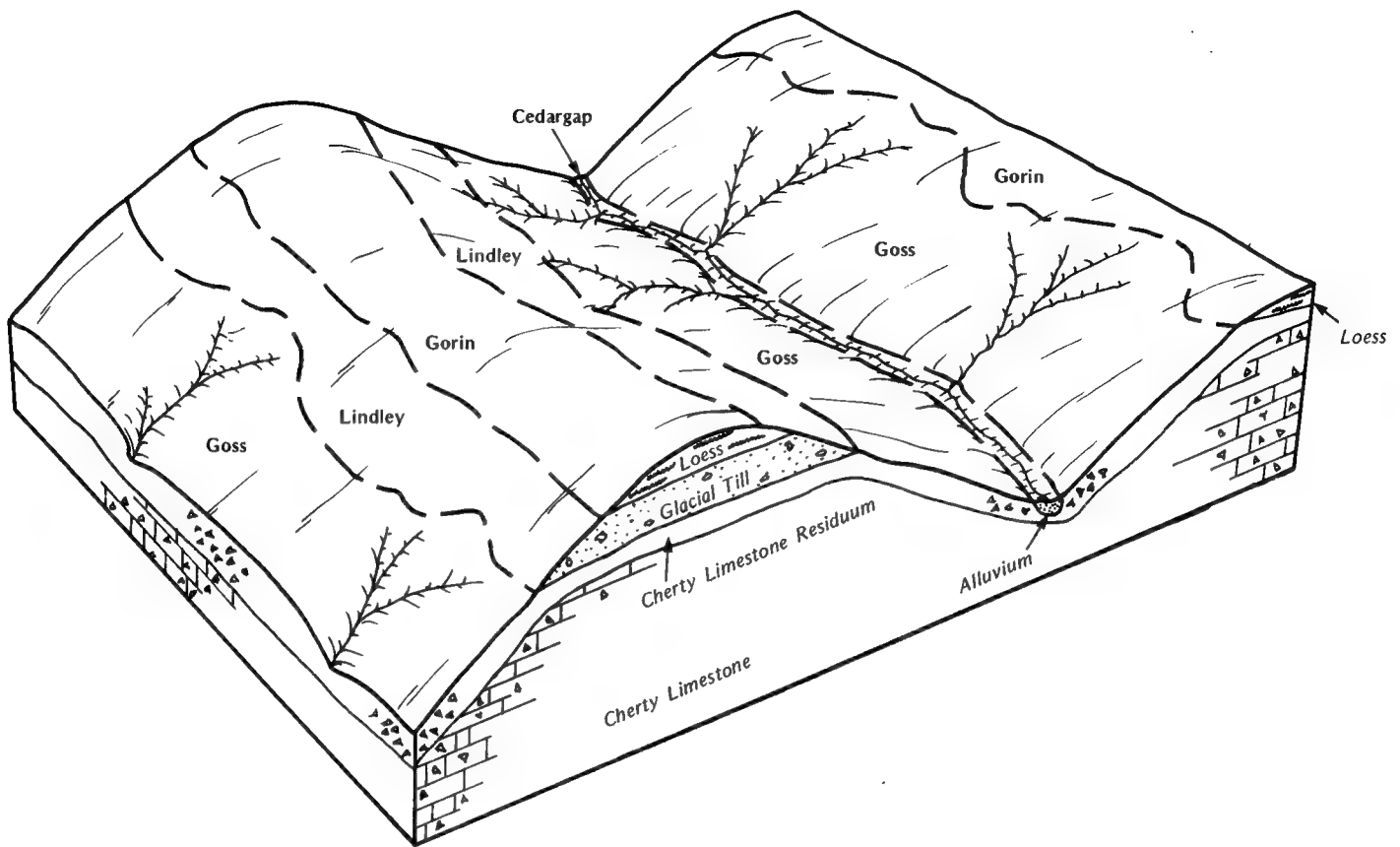


Figure 3.—Typical pattern of soils and parent material in the Goss-Gorin-Lindley association.

shrink-swell potential of the subsoil are the main limitations.

#### 4. Fatima-Belknap-Landes Association

*Nearly level, moderately well drained and somewhat poorly drained soils that formed in silty and loamy alluvium; on flood plains*

The soils in this association are on flood plains of rivers (fig. 4). The flood plains are one-fourth mile or less wide. The slopes range from 0 to 2 percent.

This association makes up about 10 percent of Marion County and 14 percent of Ralls County. It is about 24 percent Fatima soils, 17 percent Belknap soils, 15 percent Landes soils, and 44 percent minor soils.

Fatima soils are moderately well drained. Typically, they have a very dark grayish brown silt loam surface layer and subsurface layer. The subsoil is dark grayish brown silt loam. It is mottled in the lower part. The substratum is dark grayish brown, mottled silt loam.

Belknap soils are somewhat poorly drained and are the farthest from the river channel. Typically, they have a dark grayish brown silt loam surface layer. The substratum is dark grayish brown and grayish brown, mottled silt loam in the upper part and light brownish gray, mottled silt loam in the lower part.

Landes soils are moderately well drained and are closest to the river channel. Typically, they have a very dark grayish brown fine sandy loam surface layer. The subsurface layer is dark brown, friable loam, and the subsoil is dark brown friable fine sandy loam. The substratum is brown, friable fine sand.

The minor soils in this association are the poorly drained Blackoar soils on bottom lands, the poorly drained Chariton soils in higher positions on benches, and the gently sloping and moderately sloping Gifford soils on the side slopes of benches.

The soils in this association are used mainly for corn, soybeans, or wheat. In some small areas, they are used for hay. There are a few areas of woodland near streams.

The soils in this association are suited to row crops, small grains, grasses, and legumes. Flooding is the major hazard.

The soils are suited to trees although only those areas that are subject to frequent flooding are in woodland. Cottonwood, sycamore, and maple are the dominant species.

The soils generally are not suited to sanitary facilities and building site development because of the hazard of flooding.

## 5. Winfield-Menfro-Goss Association

*Gently sloping to steep, moderately well drained and well drained soils that formed in loess and in residuum of cherty limestone; on uplands*

The soils in this association are in deeply dissected areas adjacent to the flood plain of the Mississippi River and of the Salt River (fig. 5). The slopes range from 2 to 35 percent.

This association makes up about 24 percent of Marion County and 24 percent of Ralls County. It is about 37 percent Winfield soils, 37 percent Menfro soils, 8 percent Goss soils, and 18 percent minor soils.

Winfield soils are moderately sloping and strongly sloping and are on side slopes and narrow ridgetops. They are moderately well drained and formed in loess. Typically, they have a very dark grayish brown silt loam surface layer. The subsurface layer is yellowish brown and dark brown silt loam. The upper part of the subsoil is yellowish brown silty clay loam; the middle part is yellowish brown and dark yellowish brown, mottled silty clay loam; and the lower part is multicolored silty clay loam. The substratum is light brownish gray, mottled silt loam.

Menfro soils are gently sloping to steep. They are on ridgetops and side slopes upslope from the Goss soils. Menfro soils are well drained and formed in loess. Typically, the surface layer of Menfro soils is very dark grayish brown silt loam. The subsoil is dark brown silty clay loam.

Goss soils are moderately steep and steep and are on narrow ridgetops and side slopes. They are well drained and formed in residuum of cherty limestone. Typically, they have a very dark grayish brown cherty silt loam surface layer. The subsoil is cherty silty clay. The upper part is reddish brown, the middle part is yellowish red, and the lower part is yellowish brown.

The minor soils in this association are the Gosport soils, which are on the lower part of side slopes, and the Weller soils, which are on ridgetops. Gosport soils are moderately deep, and Weller soils have more clay than Menfro or Winfield soils.

About half of the acreage of the soils in this association is used for corn, soybeans, small grains, or hay. The other half, where cleared, is used as pasture, and the rest consists of steep, uneven areas that are in mixed hardwood forest.

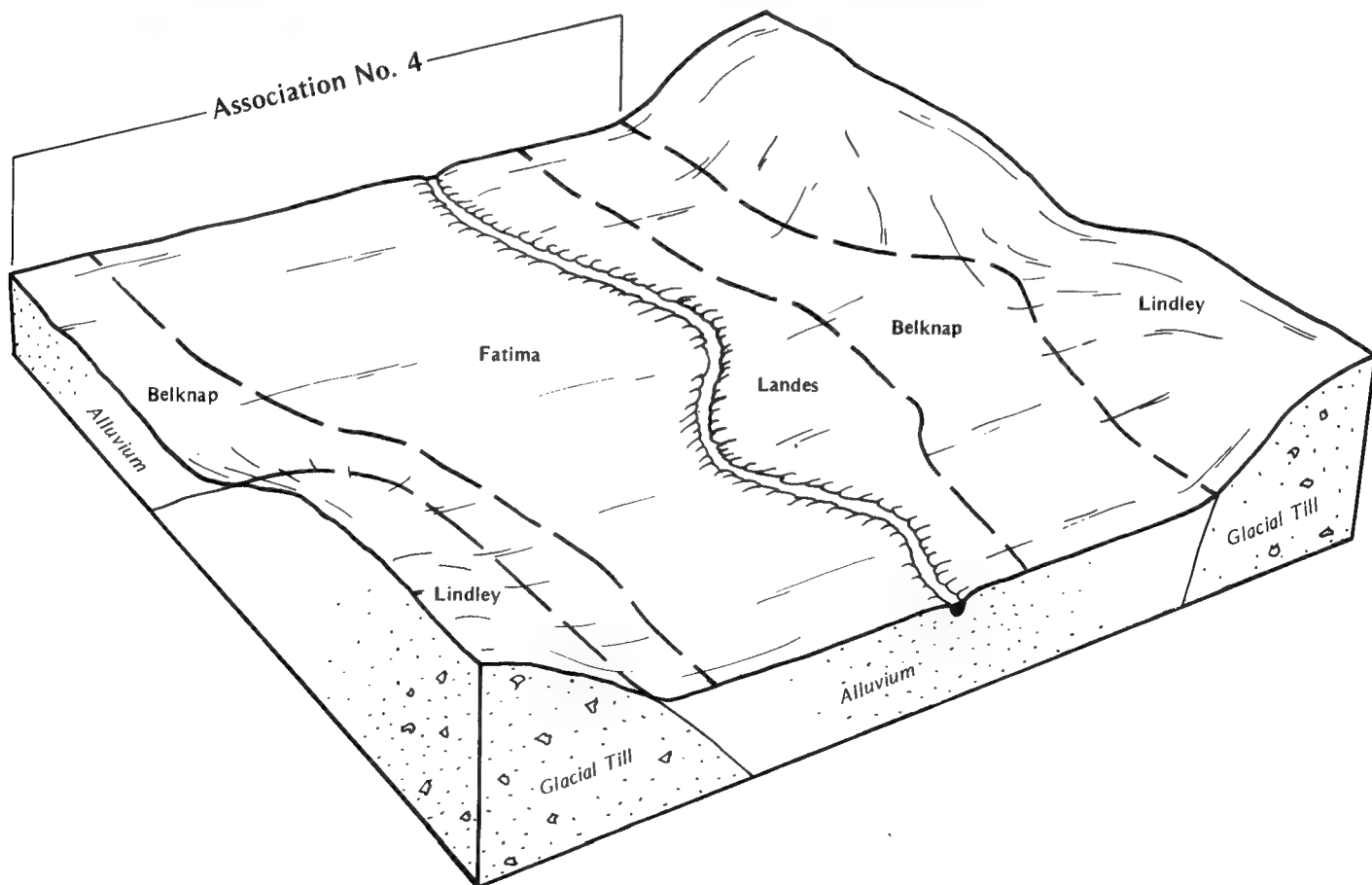


Figure 4.—Typical pattern of soils and parent material in the Fatima-Belknap-Landes association.



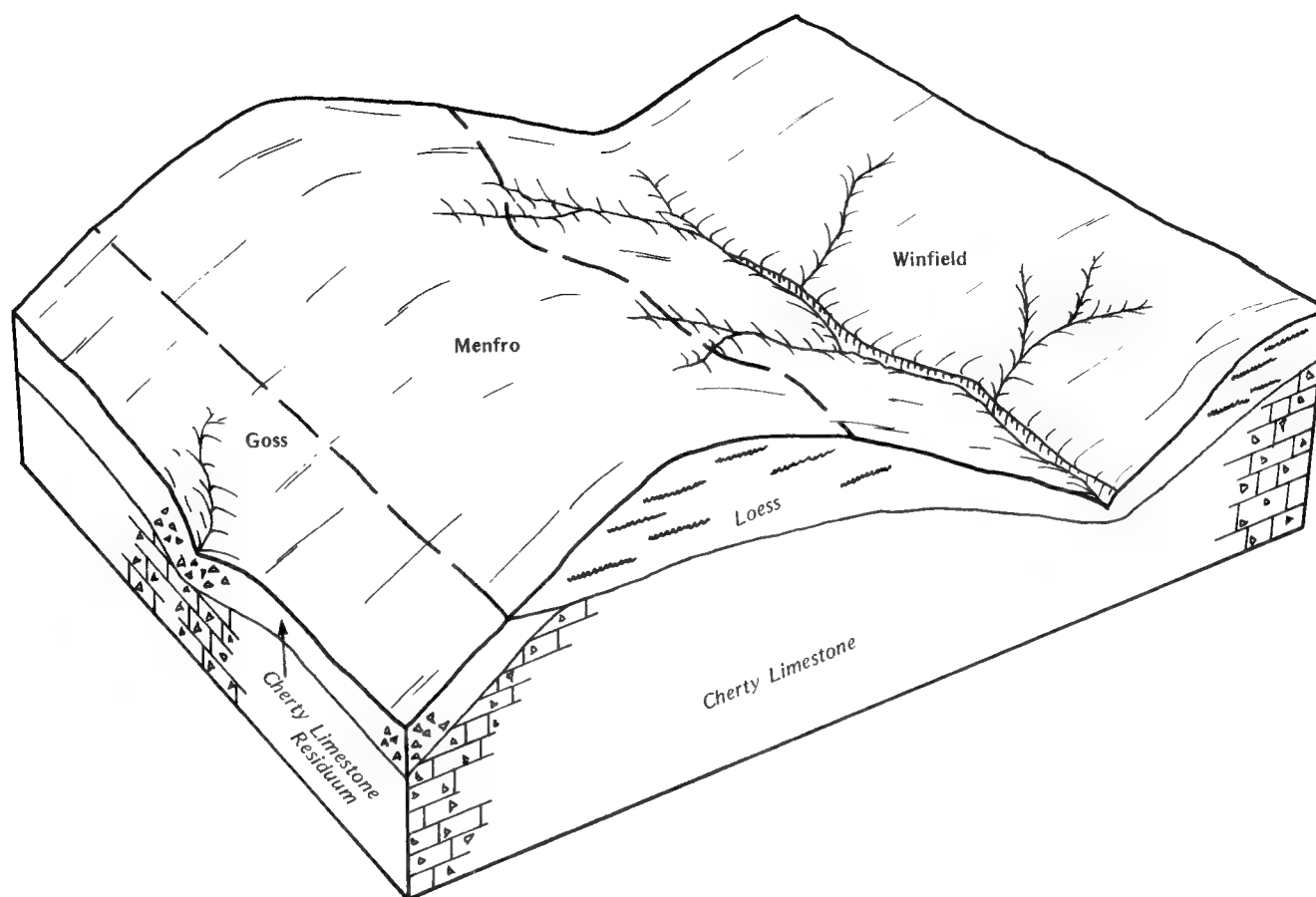


Figure 5.—Typical pattern of soils and parent material in the Winfield-Menfro-Goss association.

If the soils are used for cultivation, erosion and maintaining or improving fertility and tilth are concerns. Minimum tillage, winter cover crops, and grassed waterways help control erosion and maintain fertility and tilth. The uniform slopes can be terraced and farmed on the contour.

If the soils are used for pasture, erosion caused by overgrazing is a major concern.

The soils are well suited to trees. The Winfield and Menfro soils are well suited to orchards. Stands of woodland consist mainly of oak and hickory. Timber stand improvement is necessary for optimal production.

The soils are suited to some types of sanitary facilities and to building site development. The major limitations are slope, the moderate shrink-swell potential of the subsoil, and large stones.

## 6. Carlow-Belknap-Chequest Association

*Nearly level, poorly drained and somewhat poorly drained soils that formed in clayey and silty alluvium; on flood plains*

The soils in this association are on the flood plain of the Mississippi River. The flood plain is as much as 6 miles wide in places. It is smooth and nearly level and is interspersed with drainage ditches and their spoil banks. Differences in elevation are slight. In general, the lowest areas are along the river channel, and the elevation gradually increases toward the surrounding uplands.

This association makes up about 12 percent of Marion County and 2 percent of Ralls County. It is about 33 percent Carlow soils, 31 percent Belknap soils, 12 percent Chequest soils, and 24 percent soils of minor extent.

Carlow soils are poorly drained. They are in slight depressions in broad areas near the river. Typically, the surface and subsurface layers are very dark gray silty clay. The subsoil and substratum are dark gray, mottled silty clay.

Belknap soils are somewhat poorly drained. They are farthest from the river channel. Typically, the surface layer is dark grayish brown silt loam. The substratum is dark grayish brown and grayish brown, mottled silt loam

in the upper part and is grayish brown and light brownish gray, mottled silt loam in the lower part.

Chequest soils are poorly drained. They are in narrow areas surrounding the Carlow soils. Typically, the surface and subsurface layers are very dark gray silty clay loam. The subsoil is mottled silty clay loam. The upper part is dark gray, and the lower part is dark gray and gray.

The minor soils in this association are the Blase soils, which are in slightly elevated, elongated areas, and the Blackoar soils, which are in slight depressions.

In most areas the soils in this association are used for cultivated crops, mainly corn and soybeans. Most of the areas adjacent to the river have been leveed.

On cropland, wetness is the major concern. Land grading and surface drainage are used in some areas to overcome wetness. In other areas, underground tile is used.

The soils are suitable for trees although very few areas are in trees. Stands generally are in depressions. Cottonwood, black willow, and silver maple are the dominant species.

The soils generally are not suited to sanitary facilities and building site development. Wetness and the high content of clay are the main limitations. Also, the soils are subject to rare flooding.



# Detailed Soil Map Units

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The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Menfro silt loam, 2 to 5 percent slopes, is one of several phases in the Menfro series.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Some map units are made up of two or more major soils or one or more soils and a miscellaneous area. These map units are called soil complexes. The soils, or soils and miscellaneous areas, that make up a *soil complex* are in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Pits-Orthents complex is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

## Soil Descriptions

**2C2—Armstrong loam, 5 to 9 percent slopes, eroded.** This is a moderately sloping, moderately well drained soil on convex ridgetops and side slopes. The areas of this soil are irregularly shaped and range from about 10 to 40 acres in size.

Typically, the surface layer is very dark grayish brown loam about 6 inches thick. The subsoil is clay loam and extends to a depth of about 68 inches or more. The upper part is yellowish red and firm; the middle part is strong brown, mottled, and very firm; and the lower part is strong brown, mottled, and firm. In the severely eroded areas, the surface layer is dark brown, firm clay loam.

Included with this soil in mapping are small areas of the poorly drained Leonard soils in positions on the landscape higher than those of the Armstrong soil. Leonard soils make up less than 10 percent of the map unit.

Permeability is slow, and surface runoff is medium. The available water capacity is moderate. The surface layer varies widely in reaction because lime has been applied in places. The subsoil is very strongly acid to medium acid. Natural fertility is medium, and the content of organic matter is moderately low. The shrink-swell potential is high. A seasonal high water table is at a depth of 1 foot to 3 feet during winter and spring.

In most areas, this soil is used for cultivated crops. It is suited to corn, soybeans, and small grains. Cultivation increases the hazard of further erosion. Conservation tillage, which leaves crop residue on the surface, winter cover crops, contour farming, stripcropping, terraces, and grassed waterways help prevent excessive erosion.

Returning crop residue to the soil improves fertility and water infiltration.

This soil is suited to hay and pasture. Grasses and legumes effectively control erosion. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees. Planting large stock may be necessary to achieve a satisfactory survival rate. Frequent, light thinning reduces the hazard of windthrow.

This soil is suited to building site development and to some systems for onsite waste disposal. The high shrink-swell potential, slope, and wetness are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Drainage tiles around footings and foundations help prevent damage caused by excessive wetness. Land shaping is necessary on sites for small commercial buildings because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways reduce the damage caused by frost action and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. Leveling the site and sealing the bottom may be necessary. This soil generally is not suited to septic tank absorption fields because of the slow permeability and wetness.

Side ditches and culverts provide adequate drainage for roads and reduce damage caused by the shrinking and swelling of the soil, frost action, and wetness. Crushed rock or some other suitable base material helps prevent damage caused by the low strength.

This soil is in capability subclass IIIe. The woodland ordination symbol is 4c.

**2D2—Armstrong loam, 9 to 14 percent slopes, eroded.** This is a strongly sloping, moderately well drained soil on convex side slopes. The areas of this soil are irregularly shaped and range from about 10 to 25 acres in size.

Typically, the surface layer is very dark grayish brown loam about 6 inches thick. The subsoil is clay loam and extends to a depth of about 62 inches or more. The upper part is dark brown, mottled, and firm; the middle part is strong brown, mottled, and very firm; and the lower part is strong brown, mottled, and firm. In the severely eroded areas, the surface layer is dark brown, firm clay loam.

Included with this soil in mapping are small areas of the well drained Lindley soils on steeper slopes. Lindley soils make up less than 10 percent of the map unit.

Permeability is slow, and surface runoff is rapid. The available water capacity is moderate. The subsoil is

medium acid. Natural fertility is medium, and the content of organic matter is moderately low. The shrink-swell potential is high. A seasonal high water table is at a depth of 1 foot to 3 feet during winter and spring.

In most areas, the soil is used as pasture, hayland, or woodland. This soil is suited to occasional cultivation if erosion is carefully controlled. Conservation tillage, which leaves crop residue on the surface, winter cover crops, stripcropping, and grassed waterways help prevent excessive erosion. Uniform slopes can be terraced and contour farmed. Crop residue returned to the surface and green manure crops help control erosion, maintain or improve the organic matter content and tilth, and increase water infiltration.

Grasses and legumes for pasture and hay effectively control erosion. Overgrazing or grazing when the soil is wet compacts the surface and causes poor tilth and excessive runoff. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees, and many areas are in native hardwood forest. Planting large stock may be necessary to achieve a satisfactory survival rate. Frequent, light thinnings reduce the hazard of windthrow.

This soil is suited to building site development and to some types of onsite waste disposal. The high shrink-swell potential, wetness, and slope are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Drainage tiles around footings and foundations help prevent damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways reduce the damage caused by frost action and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. Leveling the site and sealing the bottom may be necessary. This soil generally is not suited to septic tank absorption fields because of the slow permeability and wetness.

Side ditches and culverts provide adequate drainage for roads and streets and help prevent damage caused by the shrinking and swelling of the soil, frost action, and wetness. Crushed rock or some other suitable base material helps prevent damage caused by the low strength. Roads should be designed to accommodate the slope, or some cutting and filling may be necessary.

This soil is in capability subclass IVe. The woodland ordination symbol is 4c.

**4—Belknap silt loam.** This is a nearly level, somewhat poorly drained soil on the flood plains of creeks and small rivers. It is subject to occasional, brief flooding. The areas of this soil are irregularly shaped and range from 25 to 200 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The substratum is mottled, friable silt loam and is about 61 or more inches thick. The upper part is dark grayish brown and grayish brown, and the lower part is light brownish gray. In some areas, the surface layer is very dark grayish brown and is more than 7 inches thick. In some places, the substratum is grayer.

Included with this soil in mapping are small areas of the poorly drained Carlow and Chequest soils. Carlow soils are in slight depressions and Chequest soils are in broad, slightly lower areas. The included soils make up about 10 percent of the map unit.

Permeability is moderately slow, and surface runoff is slow. The available water capacity is high. The reaction in the surface layer varies widely because lime has been applied in places. The substratum is medium acid to very strongly acid. Natural fertility is high, and the content of organic matter is moderate. The shrink-swell potential is low. A seasonal high water table is at a depth of 1 foot to 3 feet during spring.

In most areas, the soil is used for cultivated crops, hay, or pasture. It is suited to corn, soybeans, and small grains. Crops are damaged in some years because of flooding. Bedding, land leveling, and surface drainage reduce flood damage. Crop residue returned to the soil helps maintain or improve fertility and tilth.

This soil is suited to grasses and legumes for hay and pasture. Overgrazing and grazing when the soil is wet should be avoided. Proper stocking, rotation grazing, and restricted use during wet periods help maintain or improve the condition of the pasture and soil. Grasses and legumes are not likely to be damaged by flooding.

This soil is suited to trees. Plant competition can be reduced by site preparation, including spraying or cutting.

This soil generally is not suited to building site development or to onsite waste disposal because of flooding.

This soil is in capability subclass IIw. The woodland ordination symbol is 2o.

**5—Blackoar silt loam.** This is a nearly level, poorly drained soil on bottom lands along small and large streams. This soil is subject to occasional, brief flooding. The areas of this soil are irregularly shaped and range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 10 inches thick. The subsurface layer is very dark gray, very friable silt loam about 7 inches thick. The subsoil extends to a depth of 65 inches or more. The upper part is gray, mottled, friable silt loam, and the lower part is dark gray, mottled, firm silt loam. In some areas, the surface layer is dark grayish brown.

Included with this soil in mapping are small areas of the more clayey Chequest soils. Chequest soils are in positions lower than those of the Blackoar soil and are

farther from the river channels. The included soils make up less than 10 percent of the map unit.

Permeability is moderate, and surface runoff is slow. The available water capacity is very high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil is slightly acid or neutral. Natural fertility is high, and the content of organic matter is moderate. The shrink-swell potential is low. A seasonal high water table ranges from the surface to a depth of 1 foot during winter and spring.

In most areas, the soil is used for cultivated crops. This soil is suited to corn, soybeans, and small grains. Crops are damaged in some years because of flooding. Wetness is a limitation. Flood damage can be reduced by bedding, surface drains, and land leveling. Returning crop residue to the soil helps maintain or improve fertility and tilth.

This soil is suited to grasses and legumes for hay and pasture. Overgrazing and grazing when the soil is wet should be avoided. Proper stocking, rotation grazing, and restricted use during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees although there are few areas of woodland. Planting large stock may be necessary to achieve a satisfactory survival rate. Frequent, light thinning helps reduce the hazard of windthrow. The use of equipment is limited when the soil is wet. Planting and harvesting should be done when the soil is firm or dry. Site preparation, such as spraying or cutting, reduces plant competition.

This soil generally is not suited to building site development or to onsite waste disposal because of flooding.

This soil is in capability subclass IIw. The woodland ordination symbol is 3w.

**6—Blase silty clay.** This is a nearly level, somewhat poorly drained soil on the flood plains of the Mississippi River. In some places, this soil is protected from floodwaters of the Mississippi River by levees. Flooding caused by a break in the levee or by runoff from adjacent areas is rare. The areas of this soil are elongated and are slightly higher in elevation than the flood plain. They range in size from 20 to 80 acres.

Typically, the surface layer is very dark gray, firm silty clay about 9 inches thick. The subsurface layer is black, firm silty clay about 13 inches thick. The subsoil is about 13 inches thick. The upper part is dark grayish brown, mottled, firm silty clay, and the lower part is dark grayish brown, mottled, firm silty clay loam. The substratum is brown, very friable silt loam about 30 or more inches thick.

Included with this soil in mapping are small areas of the grayer Chequest soils and the more clayey Carlow soils in positions lower than those of the Blase soil. The included soils make up less than 10 percent of the map unit.

Permeability is slow in the upper part of the soil and moderate in the lower part. Surface runoff is slow, and the available water capacity is high. Reaction in the surface layer generally is slightly acid, but it may vary because lime has been applied in places. The subsoil and substratum are medium acid or neutral. Natural fertility is high, and the content of organic matter is moderate. The shrink-swell potential is high. A seasonal high water table is at a depth of 1 1/2 to 3 feet during winter and spring.

In most areas, the soil is used for cultivated crops, hay, or pasture. This soil is suited to corn, soybeans, and small grains. Crops are damaged in some years because of flooding. Wetness is a limitation. Land smoothing, leveling, and surface drains reduce the damage caused by flooding and wetness. Crop residue returned to the soil helps maintain fertility and tilth.

This soil is suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet should be avoided. Proper stocking, rotation grazing, and restricted use during wet periods help maintain or improve the condition of the pasture and soil. Grasses and legumes are not likely to be damaged by flooding.

This soil is suited to trees although there are few areas of woodland. The use of equipment is restricted, and seedling mortality and windthrow are concerns. Planting and harvesting should be delayed until the soil is firm or dry. Planting large stock may be necessary to achieve a satisfactory survival rate. Frequent, light thinnings help reduce the hazard of windthrow.

This soil generally is not suited to building site development or to onsite waste disposal because of flooding.

This soil is in capability subclass IIw. The woodland ordination symbol is 3c.

**7B—Calwoods silt loam, 2 to 5 percent slopes.** This is a gently sloping, somewhat poorly drained soil on convex ridgetops. The areas of this soil are irregularly shaped and range from about 10 to 40 acres in size. Generally, the areas are long and narrow.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsurface layer is light brownish gray, friable silt loam about 2 inches thick. The subsoil is about 46 inches thick. The upper part is yellowish brown, mottled, firm silty clay loam; the middle part is light brownish gray and grayish brown, mottled, firm silty clay; and the lower part is grayish brown, mottled, firm silty clay loam and clay loam. The substratum is light brownish gray and dark yellowish brown, mottled, very firm clay loam. In some places, the surface layer is very dark grayish brown and is more than 6 inches thick. In some areas, this soil is nearly level.

Included with this soil in mapping are areas of the moderately sloping Gorin soils in positions lower than

those of the Calwoods soil. The included soils make up less than 5 percent of the map unit.

Permeability is very slow, and surface runoff is medium. The available water capacity is high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil is strongly acid and very strongly acid. Natural fertility is medium, and the content of organic matter is moderately low. The shrink-swell potential is high. A seasonal high water table is at a depth of 1 foot to 2 1/2 feet during winter and spring.

In most areas, the soil is used as pasture or woodland. This soil is suited to corn, soybeans, and small grains. Cultivation increases the hazard of erosion. Conservation tillage, which leaves crop residue on the surface, winter cover crops, terraces, and grassed waterways help prevent excessive erosion. Returning crop residue to the surface improves fertility and water infiltration.

This soil is suited to hay and pasture. Grasses and legumes effectively control erosion. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees. Seedling mortality and windthrow are concerns. Planting large stock may be necessary to achieve a satisfactory survival rate. Frequent, light thinning reduces the hazard of windthrow.

This soil is suited to building site development and to some systems for onsite waste disposal. The high shrink-swell potential and wetness are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Drainage tiles around footings and foundations help prevent damage caused by excessive wetness. Land shaping usually is necessary on sites for small commercial buildings because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways reduce the damage caused by frost action and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. It generally is not suited to septic tank absorption fields because of wetness and the very slow permeability.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or other suitable material. Side ditches and culverts provide adequate drainage for roads and streets and help reduce damage caused by the shrinking and swelling of the soil, frost action, and wetness.

This soil is in capability subclass IIe. The woodland ordination symbol is 4c.

**8—Carlow silty clay.** This is a nearly level, poorly drained soil on the Mississippi River flood plain. This soil



is protected from flooding by levees, but it is subject to occasional flooding caused by a break in the levee or by runoff from adjacent areas. The areas of this soil are irregularly shaped and range from about 100 to 1,000 acres in size.

Typically, the surface layer is very dark gray, friable silty clay about 6 inches thick. The subsurface layer is very dark gray, mottled, firm silty clay about 6 inches thick. The subsoil is about 35 inches thick, and the substratum is about 18 or more inches thick. They are dark gray, mottled, firm silty clay. In some areas, the subsoil is silty clay loam.

Included with this soil in mapping are the somewhat poorly drained Blase soils in positions higher than those of the Carlow soil. Blase soils make up less than 5 percent of the map unit. Also included, between the Mississippi River and the levee, are small areas of soils that are frequently flooded.

Permeability and surface runoff are very slow. The available water capacity is moderate. The surface layer varies widely in reaction because lime has been applied in places. The subsoil is medium acid. Natural fertility is high, and the content of organic matter is moderate. The shrink-swell potential is high. A seasonal high water table ranges from near the surface to a depth of 1 foot during winter and spring.

In most areas, the soil is used for cultivated crops. It is suited to corn and small grains. Crops are damaged in some years because of flooding, and wetness is a limitation.

This soil is suited to grasses and legumes for hay and pasture. Pasture and hay mixtures that include water-tolerant varieties grow well on this soil. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the high water table. Proper stocking and deferment of grazing during wet periods help maintain the condition of the pasture and soil. Grasses and legumes are not likely to be damaged by flooding.

This soil is suited to trees; however, it is used as woodland in only a few areas. The use of equipment is restricted, and seedling mortality and windthrow are concerns. Plant competition can be reduced by site preparation that includes spraying or cutting. Planting and harvesting should be delayed until the soil is firm or dry. Planting large stock may be necessary for a satisfactory survival rate. Frequent, light thinning helps reduce the hazard of windthrow.

This soil generally is not suited to building site development or to onsite waste disposal because of flooding.

This soil is in capability subclass IIIw. The woodland ordination symbol is 4w.

**9—Cedargap silt loam.** This is a nearly level, well drained soil on the narrow bottom lands of small streams. It is subject to frequent flooding. Areas of this

soil generally are narrow and elongated and range from 10 to 25 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 8 inches thick. The subsurface layer extends to a depth of about 38 inches. It is dark brown, firm silt loam in the upper part and dark brown, mottled, firm extremely cherty clay loam in the lower part. The substratum is dark brown, firm extremely cherty clay loam to a depth of 68 or more inches. In places, the surface layer is cherty loam or cherty silt loam.

Included with this soil in mapping are areas of the somewhat poorly drained Belknap soils and the moderately well drained Fatima and Landes soils. The included soils make up less than 10 percent of the map unit.

Permeability is moderately rapid, and surface runoff is slow. The available water capacity is moderate. The surface layer is neutral in most places, and the subsoil is slightly acid or neutral. The natural fertility of this soil is moderately low, and the content of organic matter is moderately low. The shrink-swell potential is low.

In most areas, this soil is used for pasture, or it is idle. Use of this soil for row crops is generally not practical because the areas are narrow and inaccessible. This soil is suited to grasses and legumes for hay and pasture. Overgrazing should be avoided.

This soil is suited to trees. Planting large stock may be necessary to achieve a satisfactory survival rate. Site preparation, including spraying or cutting, reduces plant competition. Because the soil is well drained, tree roots do not always have an ample supply of moisture. Removing undesirable vegetation helps conserve moisture.

This soil generally is not suited to building site development or to onsite waste disposal because of flooding.

This soil is in capability subclass IIs. The woodland ordination symbol is 3f.

**10—Charlton silt loam.** This is a nearly level, poorly drained soil on high terraces along major streams. It is subject to rare flooding. The areas of this soil are irregularly shaped and range from 25 to 50 acres in size. They are at an elevation that is 5 to 20 feet higher than the flood plain.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer is gray, friable silt loam about 7 inches thick. The subsoil is about 34 inches thick. The upper part is dark grayish brown and grayish brown, mottled, very firm silty clay; and the lower part is grayish brown, mottled, firm silty clay loam. The substratum is gray, mottled, friable silt loam to a depth of 63 inches or more.

Included with this soil in mapping are small areas of the gently sloping and moderately sloping Gifford soils. Gifford soils are on the lower part of side slopes and make up less than 10 percent of the map unit.

Permeability and surface runoff are slow. The available water capacity is high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil ranges from strongly acid to neutral. Natural fertility is high, and the content of organic matter is moderately low. The shrink-swell potential is high. A seasonal high water table ranges from near the surface to a depth of 1 1/2 feet during winter and spring.

In most areas, the soil is cultivated. It is suited to corn, soybeans, and small grains. Wetness is the major limitation. Diversions at the base of adjacent upland slopes help keep excess water off this soil. Surface drains help remove excess water from the soil.

This soil is suited to grasses and legumes for hay and pasture. Pasture and hay mixtures that include water-tolerant varieties grow well on this soil. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the high water table. Proper stocking and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees. The use of equipment is restricted, and seedling mortality and windthrow are concerns. Plant competition can be reduced by site preparation that includes spraying or cutting. Planting and harvesting should be delayed until the soil is firm or dry. Planting large stock may be necessary for a satisfactory survival rate. Frequent, light thinning helps reduce the hazard of windthrow.

This soil is suited to building site development and to some systems for onsite waste disposal if the soil is drained and protected from flooding or if the building site is above flood level. Wetness and the high shrink-swell potential are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Buildings should be constructed on raised, well-compacted fill material. Drainage tiles around footings and foundations help prevent damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help reduce damage caused by frost action and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. Sealing the bottom of the lagoon is necessary in some places. This soil generally is not suited to septic tank absorption fields because of wetness and the slow permeability.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or some other suitable material. Roads should be built on raised, well-compacted fill material. Side ditches and culverts provide adequate drainage for roads and streets and reduce damage caused by frost action, the shrinking and swelling of the soil, and wetness.

This soil is in capability subclass IIw. The woodland ordination symbol is 5w.

**11—Chequest silty clay loam.** This is a nearly level, poorly drained soil on bottom lands. This soil is protected from floodwaters of the Mississippi River by levees. Flooding caused by a break in the levee or by runoff from adjacent areas is rare. The areas of this soil are irregularly shaped and range from about 20 to 80 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 6 inches thick. The subsurface layer is very dark gray, mottled, very firm silty clay loam about 7 inches thick. The upper part of the subsoil is dark gray, mottled, firm silty clay loam about 35 inches thick; and the lower part is dark gray and gray, mottled, firm silty clay loam about 17 inches thick. In some places, the surface layer is silt loam, and in other areas it is silty clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Blase soils. Blase soils are in slightly higher positions on the landscape than the Chequest soil and make up less than 5 percent of the map unit.

Permeability is moderately slow, and surface runoff is slow. The available water capacity is high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil is medium acid or strongly acid. Natural fertility is high, and the content of organic matter is moderate. A seasonal high water table is at a depth of 1 foot to 3 feet in winter and spring.

In most areas, the soil is used for cultivated crops. It is suited to corn, soybeans, and small grains. Crops are damaged in some years because of flooding, and wetness is a limitation.

This soil is suited to grasses and legumes for hay and pasture. Pasture and hay mixtures that include water-tolerant varieties grow well on this soil. Grasses and legumes are not likely to be damaged by flooding. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the high water table. Proper stocking and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees. The use of equipment is restricted, and seedling mortality and windthrow are concerns. Plant competition can be reduced by site preparation that includes spraying or cutting. Planting and harvesting should be delayed until the soil is firm or dry. Planting large stock may be necessary for a satisfactory survival rate. Frequent, light thinning helps reduce the hazard of windthrow.

This soil generally is not suitable for building site development or onsite waste disposal because of flooding.

This soil is in capability subclass IIw. The woodland ordination symbol is 3w.

**12—Edina silt loam.** This is a nearly level, poorly drained soil in broad upland areas. Areas of this soil are irregularly shaped and range from about 20 to 50 acres in size.

Typically, the surface layer is very dark gray, friable silt loam about 9 inches thick. The subsurface layer is dark gray, friable silt loam about 9 inches thick. The subsoil is about 41 inches thick. It is very dark gray, mottled, very firm silty clay in the upper part; dark grayish brown, mottled, firm silty clay in the middle part; and multicolored, firm silty clay in the lower part. The substratum is gray, mottled, firm silty clay loam to a depth of 63 or more inches.

Included with this soil in mapping are small areas of the gently sloping Smileyville soils. These soils make up less than 5 percent of the map unit.

Permeability and surface runoff are very slow. The available water capacity is high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil is medium acid or slightly acid. The natural fertility of this soil is high, and the content of organic matter is moderate. The shrink-swell potential is very high. A seasonal high water table is at a depth of 1/2 foot to 2 feet in winter and spring.

In most areas, the soil is cultivated. It is suited to corn, soybeans, and small grains. Wetness is the major limitation. If the area is large enough, land smoothing or leveling and surface drains are practical methods of removing excess water.

This soil is suited to grasses and legumes for hay and pasture. Grasses and legumes are not likely to be damaged by wetness unless the pasture is grazed during wet periods. Overgrazing or grazing during wet periods compacts the surface and causes poor water infiltration. Rotation grazing, proper stocking, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to building site development and to some types of onsite waste disposal. Wetness and the very high shrink-swell potential of the subsoil are the main concerns. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Drainage tiles around footings and foundations help prevent damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent damage caused by frost action and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. It generally is not suited to septic tank absorption fields because of wetness and the very slow permeability.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or other suitable material. Constructing the

subgrade on raised, well-compacted fill material and constructing side ditches and culverts that provide adequate drainage reduce damage to roads caused by the shrinking and swelling of the soil, frost action, and wetness.

This soil is in capability subclass IIw. A woodland ordination symbol was not assigned.

**13—Fatima silt loam.** This is a nearly level, moderately well drained soil mainly on flood plains of minor streams but also on flood plains of some major streams. This soil is subject to frequent flooding. The areas are irregularly shaped and range in size from 20 to 80 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsurface layer is very dark grayish brown, friable silt loam about 10 inches thick. The subsoil is dark grayish brown, friable silt loam about 32 inches thick. It is mottled in the lower part. The substratum is dark grayish brown, mottled, friable silt loam to a depth of 68 or more inches. In some places, the surface layer is dark grayish brown.

Included with this soil in mapping are areas of the sandier Landes soils, which are near the stream channel and make up less than 5 percent of the map unit.

Permeability is moderate, and surface runoff is slow. The available water capacity is very high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil is slightly acid or neutral. The natural fertility of this soil is high, and the content of organic matter is moderate. The shrink-swell potential is low. A seasonal high water table is at a depth of 3 to 5 feet during winter and spring.

In most areas, the soil is cultivated. It is suited to corn, soybeans, and small grains and to grasses and legumes for hay and pasture. Crops are damaged in some years because of flooding. Grasses and legumes are not likely to be damaged by flooding.

This soil is suited to trees. Plant competition can be reduced by site preparation, including spraying or cutting.

This soil generally is not suitable for building site development or onsite waste disposal because of flooding.

This soil is in capability subclass IIw. The woodland ordination symbol is 2o.

**14B—Gifford silt loam, 2 to 5 percent slopes.** This is a gently sloping, poorly drained soil on side slopes of stream terraces and on foot slopes adjacent to upland slopes. Areas of this soil are irregularly shaped and range from about 10 to 50 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsoil is 34 or more inches thick. The upper part is dark gray and dark grayish brown, firm silty clay; the middle part is dark grayish brown, mottled, very firm silty clay; and the lower part is grayish brown, mottled, very firm silty clay loam.

The substratum is light brownish gray, firm silt loam to a depth of 65 or more inches. In some places, the surface layer is less than 7 inches thick.

Included with this soil in mapping are areas of the nearly level Chariton soils. These soils are in positions on the landscape that are slightly higher than those of the Gifford soil and make up less than 10 percent of the map unit.

Permeability is very slow, and surface runoff is medium. The available water capacity is high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil ranges from slightly acid to strongly acid. The natural fertility of this soil is medium, and the content of organic matter is moderate. The shrink-swell potential is high. A seasonal high water table is at a depth of about 1/2 foot to 2 feet in winter and spring.

In most areas, this soil is cultivated. It is suited to corn, soybeans, and small grains although cultivation increases the hazard of erosion. Conservation tillage, which leaves crop residue on the surface, winter cover crops, contour farming, terraces, and grassed waterways help prevent excessive erosion. Returning crop residue to the surface helps improve fertility and water infiltration.

This soil is suited to grasses and legumes for hay and pasture. Use of this soil for pasture or hay effectively controls erosion. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to building site development and to some systems for onsite waste disposal if it is protected from flooding or if the building site is above flood level. The high shrink-swell potential of the subsoil, wetness, low strength, and slope are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Drainage tiles around footings and foundations help prevent damage caused by excessive wetness. Some land shaping may be necessary on sites for small commercial buildings because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent damage caused by frost action and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. Leveling the site and sealing the bottom may be necessary. This soil generally is not suited to septic tank absorption fields because of the very slow permeability and wetness.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or other suitable material. Side ditches and culverts provide adequate drainage for roads and reduce

damage caused by the shrinking and swelling of the soil, frost action, and wetness.

This soil is in capability subclass IIe. A woodland ordination symbol was not assigned.

**14C—Gifford silt loam, 5 to 9 percent slopes.** This is a moderately sloping, poorly drained soil on side slopes of stream terraces. In some places, the slopes have been dissected by erosion and shallow gullies have formed. Areas of this soil are narrow and irregular in shape and range from about 10 to 25 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is mottled, firm silty clay about 31 inches thick. The upper part is dark grayish brown, and the lower part is grayish brown. The substratum is grayish brown, friable silty clay loam to a depth of 62 inches. In some areas, the surface layer is silty clay loam, and in some areas, the surface layer is more than 10 inches thick.

Permeability is very slow, and surface runoff is medium. The available water capacity is high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil ranges from slightly acid to strongly acid. The natural fertility of this soil is medium, and the content of organic matter is moderate. The shrink-swell potential is high. A seasonal high water table is at a depth of about 1/2 foot to 2 feet during winter and spring.

In most areas, this soil is cultivated. This soil is suited to corn, soybeans, and small grains. Erosion is a hazard if this soil is used for intensive cultivation. Conservation tillage, which leaves crop residue on the surface, winter cover crops, contour strip cropping, and grassed waterways help prevent excessive erosion. Crop residue returned to the surface and green manure crops help control erosion, maintain or increase the content of organic matter, improve tilth, and increase water infiltration.

This soil is suited to grasses and legumes for hay and pasture. Use of this soil as pasture and hayland effectively controls erosion. Overgrazing reduces yields and increases weed growth. Grazing when the soil is wet compacts the surface and causes poor tilth and excessive runoff. Proper stocking, rotation grazing, and restricted use during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to building site development and to some systems for onsite waste disposal if it is protected from flooding or if the building site is above the established flood level. The high shrink-swell potential of the subsoil, wetness, low strength, and slope are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Drainage tiles around footings and foundations

help prevent damage caused by excessive wetness. Land shaping is necessary on sites for small commercial buildings because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent damage caused by frost action and by the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. Leveling the site and sealing the bottom may be necessary. This soil generally is not suited to septic tank absorption fields because of the very slow permeability and wetness.

Low strength, the high shrink-swell potential, and frost action are limitations for local roads and streets. Adding crushed rock or other suitable base material to the soil, grading the road to shed water, and providing adequate side ditches and culverts reduce damage to roads.

This soil is in capability subclass IIIe. A woodland ordination symbol was not assigned.

**15C—Gorin silt loam, 5 to 9 percent slopes.** This is a moderately sloping, somewhat poorly drained soil on convex ridgetops and side slopes. Areas of this soil are irregularly shaped and range from about 5 to 30 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 3 inches thick. The subsurface layer is brown, friable silt loam about 5 inches thick. The subsoil is about 59 inches thick. The upper part is dark yellowish brown, mottled, firm silty clay loam; the middle part is dark brown and grayish brown, mottled, firm silty clay; and the lower part is grayish brown, mottled, firm clay loam. In some places, the surface layer is 7 or more inches thick.

Included with this soil in mapping are areas of the poorly drained Marion soils in positions on the landscape higher than those of the Gorin soil. Also included are the moderately well drained Armstrong soils on the lower part of side slopes. The included soils make up less than 10 percent of the map unit.

Permeability is slow, and surface runoff is medium. The available water capacity is high. The surface layer varies widely in reaction because some areas have been cleared, and lime has been applied in places. The subsoil ranges from medium acid to very strongly acid. The natural fertility of this soil and the content of organic matter are low. The shrink-swell potential is high. A seasonal high water table is at a depth of 2 to 4 feet during winter and spring.

In most areas, the soil is used as woodland or pasture. This soil is suited to corn, soybeans, and small grains if erosion is controlled. Conservation tillage, which leaves crop residue on the surface, winter cover crops, and grassed waterways help control erosion. Uniform slopes can be terraced and contour farmed. Crop residue returned to the surface and green manure crops help control erosion, maintain or increase the content of

organic matter, improve tilth, and increase water infiltration.

This soil is suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and causes poor tilth and excessive runoff. Proper stocking, rotation grazing, and restricted use during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees. The original vegetation on this soil was trees, and some areas remain in hardwoods. Seedling mortality is a concern. Planting large stock may be necessary to achieve a satisfactory survival rate.

This soil is suited to building site development and to some systems for onsite waste disposal. The high shrink-swell potential of the subsoil, wetness, low strength, and slope are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Drainage tiles around footings and foundations help prevent damage caused by excessive wetness. Land shaping is necessary on sites for small commercial buildings because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help reduce the damage caused by frost action and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. Leveling the site and sealing the bottom may be necessary. This soil generally is not suited to septic tank absorption fields because of the slow permeability and wetness.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or other suitable material. Side ditches and culverts provide adequate drainage for roads and reduce damage caused by frost action and the shrinking and swelling of the soil.

This soil is in capability subclass IIIe. The woodland ordination symbol is 4c.

**16D—Gosport silty clay loam, 9 to 14 percent slopes.** This is a moderately deep, moderately well drained soil on side slopes along drainageways. Areas of this soil are irregularly shaped and range from about 10 to 20 acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 4 inches thick. The subsoil is about 26 inches thick. The upper part is dark brown, mottled, firm silty clay; the middle part is brown, mottled, very firm silty clay; and the lower part is gray, mottled, very firm silty clay.

Included with this soil in mapping are areas of the well drained, cherty Goss soils. Goss soils are steeper than the Gosport soil. They make up less than 10 percent of the map unit.



Permeability is very slow, and surface runoff is rapid. The available water capacity is moderate. The subsoil is medium acid to mildly alkaline. The natural fertility of this soil is low, and the content of organic matter is moderately low. The shrink-swell potential is high.

In most areas, the soil is used for pasture or hay, and it is suited to pasture and hay. This soil should be cultivated only if necessary to reestablish the pasture or to plant hay. Steepness of the slopes increases the hazard of erosion. Conservation tillage, which leaves crop residue on the surface, winter cover crops, and grassed waterways help prevent excessive erosion. Grasses and legumes also effectively control erosion. Overgrazing reduces yields and increases weed growth. Grazing when the soil is wet compacts the surface and causes poor tilth and excessive runoff. Proper stocking, rotation grazing, and restricted use during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees. In some small areas, there are stands of native hardwoods. Seedling mortality and windthrow are concerns. Planting large stock may be necessary to achieve a satisfactory survival rate. Frequent, light thinning helps reduce the hazard of windthrow.

This soil is suited to building site development, but the steepness of the slopes, the high shrink-swell potential of the subsoil, and the moderate depth to rock are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent damage caused by frost action and the shrinking and swelling of the soil. The moderate depth to bedrock can be overcome by building up the fill material or by blasting and removing the rock. Buildings should be designed to accommodate slope, or the site can be graded.

This soil generally is not suited to onsite waste disposal. In most areas, sewage can be piped to adjacent areas where the soils are suitable for onsite waste disposal.

Low strength, the shrink-swell potential, and frost action limit the use of this soil for local roads and streets. Crushed rock or some other suitable base material helps overcome the limitation of low strength. Grading the road to shed water and constructing side ditches reduce the damage caused by frost action and the shrinking and swelling of the soil.

This soil is in capability subclass Vle. The woodland ordination symbol is 5c.

**16E—Gosport silty clay loam, 14 to 20 percent slopes.** This is a moderately deep, moderately well

drained soil on side slopes along drainageways. The areas of this soil are irregular in shape and range from about 10 to 25 acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 2 inches thick. The subsurface layer is brown, firm silty clay loam about 2 inches thick. The subsoil is about 25 inches thick. It is light olive brown silty clay and light olive brown, mottled, firm clay. The substratum is mottled, dark grayish brown, olive brown, and gray, partly weathered clay shale to a depth of about 62 inches.

Included with this soil in mapping are areas of the moderately well drained Lindley soils and the well drained Goss soils on side slopes. The included soils make up less than 10 percent of the map unit.

Permeability is very slow, and surface runoff is rapid. The available water capacity is moderate. The subsoil is medium acid to mildly alkaline. The natural fertility of this soil is low, and the content of organic matter is moderately low. The shrink-swell potential is high.

This soil generally is not suited to row crops because of the steepness of the slopes.

In most areas this soil is used as woodland; in some areas it is used for pasture or hay. This soil is suited to grasses and legumes for pasture and hay. Overgrazing reduces yields and increases weed growth. Grazing when the soil is wet compacts the surface and causes poor tilth and excessive runoff. Proper stocking, rotation grazing, and restricted use during wet periods help maintain or improve the condition of the pasture and soil.

In areas of woodland, seedling mortality, windthrow, and erosion are hazards, and the use of equipment is restricted. Planting large stock may be necessary to achieve a satisfactory survival rate. Frequent, light thinning helps reduce the hazard of windthrow. Designing and constructing roads, skid trails, and fire lanes to minimize the steepness and length of the slope will reduce the hazard of erosion. Reseeding disturbed areas may be necessary after harvesting. In steep areas, it may be necessary to yard logs uphill to logging roads and skid trails.

This soil is suited to building site development, but the moderate depth to rock, the high shrink-swell potential of the subsoil, the steepness of the slopes, and low strength are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Reinforced steel, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent damage caused by frost action and the shrinking and swelling of the soil. Buildings should be designed to accommodate the slope.

This soil generally is not suited to onsite waste disposal. In most areas, sewage can be piped to

adjacent areas where the soils are suitable for onsite waste disposal.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or some other suitable material. Side ditches provide adequate drainage for roads and streets and reduce damage caused by the shrinking and swelling of the soil. The moderate depth to bedrock can be overcome by building up the fill material or by blasting and removing the rock. Roads can be designed to accommodate the slope, but some leveling and blasting generally is necessary.

This soil is in capability subclass VIIe. The woodland ordination symbol is 5c.

**17F—Goss cherty silt loam, 15 to 30 percent slopes.** This is a moderately steep and steep, well drained soil on side slopes and ridgetops along drainageways and major streams. The areas are irregular in shape and range from about 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable cherty silt loam about 5 inches thick. The subsoil extends to a depth of about 62 inches or more. The upper part is reddish brown, firm cherty silty clay; and the lower part is yellowish red and yellowish brown, very firm cherty silty clay.

Included with this soil in mapping are areas of the well drained Menfro soils, the moderately well drained Winfield and Armstrong soils, and the somewhat poorly drained Gorin soils. These soils are upslope from the Goss soil and are not cherty. In some places, there are rock outcrops and ledges, and large boulders and rock fragments are on the surface. The included areas make up less than 10 percent of the map unit.

Permeability is moderate, and surface runoff is rapid. The available water capacity is low. The subsoil is slightly acid to strongly acid. Natural fertility is low, and the content of organic matter is moderately low. The shrink-swell potential is moderate.

This soil is used mainly as woodland. It is suited to trees, and most areas are in native hardwood forest. Seedling mortality is a concern. Planting is limited somewhat by stones and by droughtiness. Planting seedlings by hand and planting larger stock than is standard may be necessary to achieve a successful stand. Direct seeding can also be employed. The use of equipment in harvesting is restricted by the steep slopes and the chert. Roads and skid trails should be built on the contour. In steep areas, it may be necessary to yard logs uphill to logging roads or skid trails. Thinning and selective cutting may be necessary to improve existing stands.

This soil generally is not suited to building site development or to sanitary facilities because of the steep slopes and the chert. This soil can be made suitable for low-density buildings by extensive site preparation.

This soil is in capability subclass VIIs. The woodland ordination symbol is 4f.

**19—Landes fine sandy loam.** This is a nearly level, moderately well drained soil on the flood plains of major and minor streams. It is subject to occasional flooding. The areas of this soil are irregular in shape and range from about 20 to 80 acres in size.

Typically, the surface layer is very dark grayish brown, very friable fine sandy loam about 7 inches thick. The subsurface layer is dark brown, friable loam about 13 inches thick. The subsoil is dark brown, friable fine sandy loam about 18 inches thick. The substratum is brown, friable fine sand about 22 or more inches thick.

Included with this soil in mapping are areas of the moderately well drained Fatima soils, which are farther from the stream channel than the Landes soil. Fatima soils make up less than 10 percent of the map unit.

Permeability is moderately rapid, and surface runoff is slow. The available water capacity is moderate. The soil is slightly acid or neutral throughout. Natural fertility is low, and the content of organic matter is moderately low. The shrink-swell potential is low. A seasonal high water table is at a depth of 4 to 6 feet during spring.

In most areas, this soil is cultivated. It is suited to corn, soybeans, and small grains. Crops are damaged in some years unless the soil is protected from flooding.

This soil is suited to hay and pasture. Because of the fine sandy loam surface layer, however, overgrazing quickly destroys the grasses. Proper stocking and restricted use during dry periods help maintain or improve the condition of the pasture. Grasses and legumes are not likely to be damaged by flooding.

This soil is suited to trees. Plant competition can be reduced by site preparation that includes spraying or cutting.

This soil generally is not suited to building site development or to onsite waste disposal because of flooding.

This soil is in capability subclass IIw. The woodland ordination symbol is 1o.

**20C—Leonard silt loam, 5 to 9 percent slopes.** This is a moderately sloping, poorly drained soil on convex ridgetops and at the head of drainageways. The areas of this soil are irregular in shape and range from 20 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 57 or more inches thick. The upper part is dark grayish brown, mottled, firm silty clay loam; the middle part is dark grayish brown, gray, and grayish brown, mottled, very firm silty clay; and the lower part is light brownish gray, mottled, very firm silty clay. There are small white fragments of chert in the middle and lower parts of the subsoil. In some places, the subsoil is redder than is typical.



Included with this soil in mapping are small areas of the moderately well drained Armstrong soils on the lower part of side slopes. The included soils make up less than 10 percent of the map unit.

Permeability is slow, and surface runoff is medium. The available water capacity is moderate. The surface layer varies widely in reaction because lime has been applied in places. The subsoil ranges from neutral to very strongly acid. The natural fertility of this soil is high, and the content of organic matter is moderate. The shrink-swell potential is high. A seasonal high water table is at a depth of 1/2 foot to 2 feet during winter and spring.

In most areas, this soil is cultivated. It is suited to corn, soybeans, and small grains. Cultivation increases the hazard of erosion. Conservation tillage, which leaves crop residue on the surface, winter cover crops, contour farming, stripcropping, and terraces that have suitable outlets help prevent excessive erosion. Returning crop residue to the surface helps improve fertility and water infiltration.

This soil is suited to grasses and legumes for hay and pasture. The use of this soil as pasture or hayland effectively controls erosion. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees. Seedling mortality and windthrow are concerns. Planting large stock may be necessary to achieve a satisfactory survival rate. Frequent, light thinning may be necessary to reduce the hazard of windthrow.

This soil is suited to building site development and to some systems for onsite waste disposal, but the high shrink-swell potential of the subsoil, wetness, low strength, and slope are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Drainage tiles around footings and foundations help prevent damage caused by excessive wetness. Land shaping is necessary on sites for small commercial buildings because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent damage caused by frost action and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. Some leveling may be necessary because of the slope. This soil generally is not suited to septic tank absorption fields because of wetness and the slow permeability.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or other suitable material. Side ditches and

culverts provide adequate drainage for roads and reduce damage caused by the shrinking and swelling of the soil, frost action, and wetness.

This soil is in capability subclass IIIe. The woodland ordination symbol is 5c.

**21E—Lindley loam, 14 to 20 percent slopes.** This is a moderately steep, moderately well drained soil on side slopes and narrow ridgetops. The areas are irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is very dark gray, friable loam about 2 inches thick. The subsurface layer is dark grayish brown, friable loam about 4 inches thick. The upper part of the subsoil is dark brown and dark yellowish brown, mottled, firm clay loam about 11 inches thick, and the lower part of the subsoil is yellowish brown, mottled, very firm clay loam about 14 inches thick. The substratum is yellowish brown, firm clay loam to a depth of about 60 inches.

Included with this soil in mapping are areas of the steep, cherty Goss soils. The included soils make up less than 10 percent of the map unit.

Permeability is moderately slow, and surface runoff is rapid. The available water capacity is high. The subsoil is very strongly acid or strongly acid. Natural fertility is low, and the content of organic matter is moderately low. The shrink-swell potential is moderate. A seasonal high water table is at a depth of 2 to 3 1/2 feet in winter and spring.

This soil is used mainly as pasture or woodland. This soil is too steep to be cultivated. It should be tilled only if necessary in reseeding grasses and legumes. Seed should be planted early so that a ground cover can be well established before the end of the growing season. The use of this soil as pasture effectively controls erosion. Overgrazing or grazing when the soil is wet, however, compacts the surface and causes poor tilth and excessive runoff. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

The soil is suited to trees, and in some areas there are large stands of native hardwoods. Erosion is a hazard, and the use of equipment for harvesting is restricted because of the steep slopes. Harvesting should be done when the soil is dry and firm or when the soil is frozen. Roads and skid trails should be constructed on the contour. Yarding logs uphill may be necessary in the steep areas. Seeding disturbed areas after harvesting and planting seedlings by hand also may be necessary.

This soil generally is not suitable for building site development or for onsite waste disposal because of the steep slopes and wetness.

This soil is in capability subclass VIe. The woodland ordination symbol is 4r.

**21F—Lindley loam, 20 to 35 percent slopes.** This is a steep, moderately well drained soil on ridgetops and

side slopes of uplands. The areas are irregular in shape and are about 10 to 60 acres in size.

Typically, the surface layer is very dark grayish brown, very friable loam about 2 inches thick. The subsurface layer is dark grayish brown, friable loam about 4 inches thick. The subsoil is about 25 inches thick and is yellowish brown, firm clay loam. It is mottled in the lower part. The substratum extends to a depth of about 67 inches or more. It is yellowish brown, firm clay loam. In some places, the surface layer is 7 or more inches thick.

Included with this soil in mapping are areas of the cherty Goss soils on the lower part of side slopes. These soils make up less than 10 percent of the map unit.

Permeability is moderately slow, and surface runoff is rapid. The available water capacity is high. The subsoil is very strongly acid or strongly acid. The natural fertility of this soil is low, and the content of organic matter is moderately low. The shrink-swell potential is moderate. A seasonal high water table is at a depth of 2 to 3 1/2 feet during winter and spring.

The use of this soil as pasture effectively controls erosion. Pasture grasses can be grown in cleared areas. The steep slopes restrict the seeding operations. The soil should be tilled only when necessary to reseed grasses and legumes. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

In most areas, this soil is used as woodland, and it is suited to use as woodland. The use of equipment is limited because of the steep slopes, and erosion is a hazard. Trees should be harvested when the soil is dry and firm or when it is frozen. Roads and skid trails should be constructed on the contour. Yarding logs uphill may be necessary in steep areas. Seeding disturbed areas after harvesting and planting seedlings by hand also may be necessary.

This soil generally is not suitable for building site development or for onsite waste disposal because of the steep slopes and wetness.

This soil is in capability subclass VIIe. The woodland ordination symbol is 4r.

**22B—Marion silt loam, 2 to 5 percent slopes.** This is a gently sloping, somewhat poorly drained soil on high terraces adjacent to large and medium-sized streams. The areas are irregular in shape and are about 5 to 15 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 3 inches thick. The subsurface layer is grayish brown and light brownish gray, friable silt loam about 10 inches thick. The subsoil is about 38 inches thick. The upper part is brown, mottled, firm silty clay, and the lower part is grayish brown, mottled, very firm silty clay loam. The substratum is grayish brown, friable silty clay loam about 12 or more inches thick.

Included with this soil in mapping are areas of the poorly drained Chariton soils in positions on the landscape that are slightly higher than those of the Marion soil. Chariton soils make up less than 10 percent of the map unit.

Permeability is very slow, and surface runoff is medium. The available water capacity is high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil is strongly acid or very strongly acid. The natural fertility of this soil is low, and the content of organic matter is moderately low. The shrink-swell potential is high. A seasonal high water table is at a depth of 1 foot to 2 feet during winter and spring.

In most areas, this soil is cultivated. It is suited to corn, soybeans, and small grains. Erosion is a hazard if the soil is continually cultivated. Conservation tillage, which leaves crop residue on the surface, contour farming, grassed waterways, and winter cover crops help control erosion. Returning crop residue to the soil and growing green manure crops also help control erosion.

This soil is suited to hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and causes poor tilth and excessive runoff. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees, and in some areas there are small stands of native hardwoods. Seedling mortality and windthrow are concerns. Plant competition can be reduced by site preparation that includes spraying or cutting. Planting large stock may be necessary for a satisfactory survival rate. Frequent, light thinning helps reduce the hazard of windthrow.

This soil is suited to building site development and to some systems for onsite waste disposal. The high shrink-swell potential of the soil and wetness are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Drainage tiles around footings and foundations help prevent damage caused by excessive wetness. Some land shaping usually is necessary on sites for small commercial buildings because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent damage caused by frost action and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. Some leveling is necessary because of the slope. This soil generally is not suited to septic tank absorption fields because of wetness and the very slow permeability.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or some other suitable material. Constructing roads on a raised, well-compacted

subgrade and constructing side ditches and culverts that provide adequate drainage help prevent damage caused by the shrinking and swelling of the soil, frost action, and wetness.

This soil is in capability subclass IIIe. The woodland ordination symbol is 5c.

**23B—Menfro silt loam, 2 to 5 percent slopes.** This is a gently sloping, well drained soil on broad ridgetops adjacent to the Mississippi River flood plain. The areas are irregular in shape and range from about 10 to 150 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer is dark brown, friable silt loam about 5 inches thick. The subsoil is about 37 inches thick. The upper part is dark brown, firm silty clay loam; and the lower part is dark yellowish brown, very firm silt loam. The substratum is dark yellowish brown and yellowish brown, very friable silt loam to a depth of about 67 inches. In some areas the surface layer is less than 9 inches thick.

Included with this soil in mapping are small areas of the moderately well drained Weller soils in nearly level areas. Weller soils make up less than 10 percent of the map unit.

Permeability is moderate, and surface runoff is slow. The available water capacity is high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil is medium acid to neutral. Natural fertility is high, and the content of organic matter is moderately low. The shrink-swell potential is moderate.

In most areas, this soil is cultivated. It is suited to corn, soybeans, and small grains. Erosion is a hazard in cultivated areas. Conservation tillage, which leaves crop residue on the surface, and winter cover crops help prevent serious damage caused by erosion. Areas that have uniform slopes can be terraced and farmed on the contour. Crop residue returned to the surface and green manure crops help control erosion.

This soil is suited to hay and pasture. Grasses and legumes effectively control erosion. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees, and in some small areas there are stands of native hardwoods. The limitations are slight. Walnut trees grow well on this soil.

This soil is suited to building site development and to onsite waste disposal systems, but the moderate shrink-swell potential of the subsoil and slope are limitations, and seepage is a hazard. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and

backfilled with sand or gravel. Land shaping generally is necessary on sites for small commercial buildings because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways reduce the damage caused by frost action and the shrinking and swelling of the soil.

Septic tank absorption fields function adequately if they are properly constructed. Onsite investigation is necessary to select the best site for a sewage lagoon. In some places, the bottom of the lagoon must be sealed to prevent seepage.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or some other suitable material. Side ditches and culverts provide adequate drainage for roads and streets and reduce damage caused by frost action and the shrinking and swelling of the soil.

The soil is in capability subclass IIe. The woodland ordination symbol is 3o.

**23C2—Menfro silt loam, 5 to 9 percent slopes, eroded.** This is a moderately sloping, well drained soil on ridgetops and side slopes adjacent to the Mississippi River flood plain. The areas are irregular in shape and range from about 10 to 120 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 56 inches thick and is dark brown, firm silty clay loam. In some areas, the surface layer is more than 6 inches thick. In some small areas, nearly all of the surface layer has been removed by erosion.

Permeability is moderate, and surface runoff is medium. The available water capacity is high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil is strongly acid or medium acid. Natural fertility is high, and the content of organic matter is moderately low. The shrink-swell potential is moderate.

In most areas, the soil is cultivated. It is suited to corn, soybeans, and small grains. Erosion is a hazard in cultivated areas. Conservation tillage, which leaves crop residue on the surface, contour farming, terraces, grassed waterways, and winter cover crops help prevent excessive erosion. Areas that have uniform slopes can be terraced and farmed on the contour. Crop residue returned to the surface and green manure crops also help control erosion.

This soil is suited to hay and pasture. Grasses and legumes effectively control erosion. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees, and in some areas there are stands of native hardwoods. The limitations are slight. Walnut trees grow well on this soil.

This soil is suited to building site development and to onsite waste disposal systems, but the slope and shrink-swell potential are limitations. The shrink-swell potential is a moderate limitation. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Land shaping is necessary on sites for small commercial buildings because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways reduce the damage caused by frost action and the shrinking and swelling of the soil.

This soil is well suited to septic tank absorption fields. Sewage lagoons function satisfactorily if they are sealed with a slowly permeable material. Constructing lagoons in the less sloping areas requires less leveling and less banking.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or some other suitable material. Side ditches and culverts provide adequate drainage for roads and streets and reduce damage caused by frost action and the shrinking and swelling of the soil.

The soil is in capability subclass IIIe. The woodland ordination symbol is 3o.

**23D2—Menfro silt loam, 9 to 14 percent slopes, eroded.** This is a strongly sloping, well drained soil on side slopes adjacent to the Mississippi River flood plain. The areas of this soil are irregularly shaped and range from about 20 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsoil is dark yellowish brown and dark brown, firm silty clay loam about 56 inches thick. In a few areas, the surface layer is more than 6 inches thick. In some small areas, nearly all of the surface layer has been removed by erosion.

Permeability is moderate, and surface runoff is medium. The available water capacity is high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil ranges from strongly acid to slightly acid. Natural fertility is high, and the content of organic matter is moderately low.

This soil is suited to corn, soybeans, and small grains. Erosion is a severe hazard. Conservation tillage, which leaves crop residue on the surface, winter cover crops, contour farming, stripcropping, and terraces help prevent excessive erosion. Returning crop residue to the surface improves fertility and water infiltration.

The use of this soil as pasture or hayland effectively controls erosion. Alfalfa grows very well. Overgrazing should be avoided. Grazing when the soil is wet compacts the surface and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, and

deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees. Walnut trees grow well on this soil. The hazards and limitations are slight.

This soil is suited to building site development and to onsite waste disposal systems, but the shrink-swell potential and slope are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Land shaping generally is necessary, or dwellings can be designed to accommodate the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent the damage caused by frost action and the shrinking and swelling of the soil.

Septic tank absorption fields function satisfactorily if the slope is graded. Absorption field laterals should be installed parallel to the slope. This soil is more suitable for sewage lagoons than for absorption fields in areas that can be leveled. Sealing the bottom of the lagoon may be necessary to prevent seepage.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or some other suitable material. Side ditches and culverts provide adequate drainage for roads and streets and reduce damage caused by frost action and the shrinking and swelling of the soil. Land shaping may be necessary to reduce the slope.

This soil is in capability subclass IIIe. The woodland ordination symbol is 3o.

**23E—Menfro silt loam, 14 to 20 percent slopes.**

This is a moderately steep, well drained soil on side slopes adjacent to the Mississippi River flood plain. Areas of this soil are irregularly shaped and range from about 10 to 80 acres in size.

Typically, the surface layer is dark brown, very friable silt loam about 3 inches thick. The subsurface layer is yellowish brown, very friable silt loam about 7 inches thick. The subsoil is about 43 inches thick. The upper part is dark brown, friable silt loam, and the lower part is dark brown and dark yellowish brown, firm silty clay loam. The substratum is dark yellowish brown, friable silt loam to a depth of about 64 inches. On the lower part of some side slopes, there are gray mottles in the lower part of the subsoil. In places, the subsoil is loam and is redder than is typical.

Permeability is moderate, and surface runoff is rapid. The available water capacity is high. The subsoil is strongly acid. Natural fertility is high, and the content of organic matter is moderately low. The shrink-swell potential is moderate.

In most areas, this soil is used as pasture or woodland. Use of this soil for pasture effectively controls erosion. Overgrazing or grazing when the soil is wet

compacts the surface and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees, and in some areas there are stands of native hardwoods. Erosion and seedling mortality are concerns, and the use of equipment is limited. Planting and harvesting should be delayed until the soil is dry and firm. Roads and skid trails should be laid out on the contour. Yarding logs uphill may be necessary in steep areas. Planting large stock may be necessary to achieve a satisfactory survival rate.

This soil is suited to building site development and to onsite waste disposal systems, but the slope and shrink-swell potential are limitations. Land shaping may be necessary, or dwellings can be designed to accommodate the slope. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent the damage caused by frost action and the shrinking and swelling of the soil.

Septic tank absorption fields function satisfactorily on this soil. Land shaping is necessary, or the absorption field can be designed to accommodate the slope. In some places, sewage can be piped to an adjacent area where the soil is not so steep.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or some other suitable material. Side ditches and culverts provide adequate drainage for roads and streets and reduce the damage caused by frost action and the shrinking and swelling of the soil.

This soil is in capability subclass IVe. The woodland ordination symbol is 3r.

### **23F—Menfro silt loam, 20 to 35 percent slopes.**

This is a steep, well drained soil on side slopes adjacent to the Mississippi River flood plain. Areas of this soil are irregularly shaped and range from about 10 to 40 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 2 inches thick. The subsurface layer is brown, friable silt loam about 5 inches thick. The subsoil is about 45 inches thick. The upper part is dark brown, friable silt loam; the middle part is dark brown, firm silty clay loam; and the lower part is strong brown, firm silty clay loam. The substratum is yellowish brown, friable silt loam to a depth of about 68 inches. On the lower part of some side slopes, there are grayish brown mottles in the lower part of the subsoil. In places the subsoil is loam and is redder than is typical.

Included with this soil in mapping are small areas of the cherty Goss soils on the lower part of side slopes. They make up less than 10 percent of the map unit.

Permeability is moderate, and surface runoff is rapid. The available water capacity is high. The soil is strongly acid to slightly acid. Natural fertility is high, and the content of organic matter is moderately low. The shrink-swell potential is moderate.

In most areas, this soil is used as pasture or as woodland. This soil generally is not suited to use as cropland. It should be tilled only if necessary to reseed grasses and legumes. Grasses and legumes effectively control erosion. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, and timely deferment of grazing help maintain or improve the condition of the pasture and soil.

This soil is suited to trees, and in some areas there are stands of native hardwoods. The use of equipment is limited, and erosion and seedling mortality are hazards. The use of equipment should be delayed until the soil is dry and firm. A ground cover effectively controls erosion. Roads and skid trails should be constructed on the contour. Yarding logs uphill may be necessary in steep areas. Planting large stock may be necessary to achieve a satisfactory survival rate.

This soil generally is not suited to building site development or to onsite waste disposal systems because of the steepness of the slopes. This soil can, however, be used as a site for low density buildings if the site is extensively prepared.

This soil is in capability subclass VIe. The woodland ordination symbol is 3r.

**24B2—Mexico silty clay loam, 2 to 5 percent slopes, eroded.** This is a gently sloping, somewhat poorly drained soil on broad, convex ridgetops. The areas of this soil are irregularly shaped and range from about 15 to 80 acres in size.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 8 inches thick. The subsoil is about 29 inches thick. The upper part is dark grayish brown, mottled, firm silty clay; the middle part is grayish brown and gray, mottled, very firm silty clay; and the lower part is grayish brown, mottled, firm silty clay loam. The substratum is gray, mottled, firm silty clay loam to a depth of 66 inches.

Included with this soil in mapping are the poorly drained Putnam soils in nearly level areas and the moderately well drained Armstrong soils on the lower part of side slopes. The included soils make up less than 10 percent of the map unit.

Permeability is very slow, and the surface runoff is medium. The available water capacity is high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil is medium acid or strongly acid. Natural fertility is medium, and the content



of organic matter is moderate. The shrink-swell potential is high. A seasonal high water table is at a depth of 1 foot to 2 feet during winter and spring.

In most areas, this soil is cultivated. It is suited to corn, soybeans, and small grains. Cultivation increases the hazard of further erosion. Conservation tillage, which leaves crop residue on the surface, winter cover crops, contour farming, and terraces help prevent excessive erosion. Returning crop residue to the surface helps improve fertility and water infiltration. If this soil is tilled to a depth of more than 8 inches, subsoil material is incorporated into the surface layer, and the yields of small grains decrease.

This soil is suited to pasture and hay. Grasses and legumes effectively control erosion. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees. Seedling mortality and windthrow are hazards. Planting large stock may be necessary to achieve a satisfactory survival rate. Frequent, light thinning reduces the hazard of windthrow.

This soil is suited to building site development and to some systems for onsite waste disposal, but the high shrink-swell potential and wetness are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Drainage tiles around footings and foundations help prevent damage caused by excessive wetness. Land shaping usually is necessary on sites for small commercial buildings because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent damage caused by frost action and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. This soil generally is not suited to septic tank absorption fields because of wetness and the very slow permeability.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or some other suitable material. Roads should be constructed on raised, well-compacted fill material. Side ditches and culverts provide adequate drainage for roads and help prevent damage caused by the shrinking and swelling of the soil, frost action, and wetness.

This soil is in capability subclass IIIe. The woodland ordination symbol is 4c.

**25—Moniteau silt loam.** This is a nearly level, poorly drained soil on bottom lands and low terraces. It is subject to occasional flooding. The areas of this soil are irregularly shaped and range from 10 to 50 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer is gray, friable silt loam about 8 inches thick. The subsoil is 47 or more inches thick. The upper part is grayish brown, mottled, firm silty clay loam, and the lower part is grayish brown, mottled, firm silt loam.

Included with this soil in mapping are areas of the somewhat poorly drained Belknap soils and the moderately well drained Landes soils. These soils are in positions on the landscape slightly higher than those of the Moniteau soil. The included soils make up less than 10 percent of the map unit.

Permeability and surface runoff are slow. The available water capacity is high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil ranges from medium acid to very strongly acid. Natural fertility is low, and the content of organic matter is moderate. The shrink-swell potential is moderate. A seasonal high water table ranges from near the surface to a depth of 2 feet in winter and spring.

In most areas, this soil is cultivated. This soil is suited to corn, soybeans, and small grains. Wetness is a limitation. Flooding damages crops in some years.

This soil is suited to pasture and hay. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, and restricted use during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees, and in some areas there are small stands of native hardwoods. The use of equipment is restricted, and seedling mortality and windthrow are concerns. Plant competition can be reduced by site preparation that includes spraying or cutting. Planting and harvesting should be delayed until the soil is firm or dry. Planting large stock may be necessary for a satisfactory survival rate. Frequent, light thinning helps reduce the hazard of windthrow.

This soil generally is not suited to building site development or onsite waste disposal because of flooding.

This soil is in capability subclass IIIw. The woodland ordination symbol is 4w.

**26—Putnam silt loam.** This is a nearly level, poorly drained soil on flat, broad uplands. The areas are irregular in shape and range from about 10 to 1,000 acres in size.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 9 inches thick. The subsurface layer is gray, very friable silt loam about 7 inches thick. The subsoil is about 32 inches thick. The upper part is dark gray, mottled, very firm silty clay; the middle part is dark grayish brown, mottled, very firm silty clay; and the lower part is grayish brown, mottled, very firm silty clay and silty clay loam. The substratum is gray, mottled, friable silty clay loam to a depth of 62 inches or

more. In some places, the surface layer is dark grayish brown.

Permeability is very slow, and surface runoff is slow. The available water capacity is high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil is strongly acid or very strongly acid. Natural fertility is high, and the content of organic matter is moderately low. The shrink-swell potential is moderate. A seasonal high water table is at a depth of 1/2 foot to 1 1/2 feet during winter and spring.

In most areas, this soil is cultivated. It is suited to corn, soybeans, and small grains. Wetness is the major limitation. Returning crop residue to the surface helps maintain the content of organic matter. Surface drainage methods, such as shallow ditches and land grading, are practical in large areas.

This soil is suited to hay and pasture. Overgrazing or grazing when the soil is wet compacts the surface and causes poor water infiltration. Rotation grazing, proper stocking, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil. Grasses and legumes are not likely to be damaged by wetness.

This soil is suited to building site development and to some systems for onsite waste disposal, but the shrink-swell potential and wetness are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Land shaping to improve surface drainage and drainage tile around footings and foundations help prevent damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent damage caused by frost action and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. This soil generally is not suited to septic tank absorption fields because of wetness and the very slow permeability.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or some other suitable material. Roads should be constructed on raised, well-compacted fill material. Side ditches and culverts provide adequate drainage and help reduce damage caused by the shrinking and swelling of the soil, wetness, and frost action.

This soil is in capability subclass IIw. A woodland ordination symbol was not assigned.

**27C—Sampsel silty clay loam, 5 to 9 percent slopes.** This is a moderately sloping, poorly drained soil on ridgetops and side slopes. The areas are irregularly shaped and range from about 5 to 15 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 5 inches thick. The subsurface layer

is black, friable silty clay loam about 10 inches thick. The subsoil is about 53 inches thick. The upper part is olive gray, mottled, firm silty clay; the middle part is light olive gray, mottled, firm silty clay; and the lower part is gray, mottled, very firm silty clay.

Included with this soil in mapping are small areas of the moderately well drained Gosport soils on the lower part of side slopes. Gosport soils make up less than 10 percent of the map unit.

Permeability is slow, and surface runoff is medium. The available water capacity is moderate. Reaction is slightly acid or neutral throughout. Natural fertility is medium, and the content of organic matter is moderate. The shrink-swell potential is high. A seasonal high water table ranges from near the surface to a depth of 1 1/2 feet during winter and spring.

In most areas, this soil is cultivated. This soil is suited to corn and soybeans. Cultivation increases the hazard of erosion. Conservation tillage, which leaves crop residue on the surface, contour farming, terraces, grassed waterways, and winter cover crops help prevent excessive erosion. Crop residue returned to the surface and green manure crops also help control erosion.

This soil is suited to grasses and legumes for pasture and hay. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to building site development and to some systems for onsite waste disposal, but the high shrink-swell potential and wetness are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Drainage tiles around footings and foundations help prevent damage caused by excessive wetness. Land shaping is necessary on sites for small commercial buildings because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent damage caused by frost action and the shrinking and swelling of the soil. Land leveling is necessary because of the slope.

This soil is suitable for sewage lagoons. This soil generally is not suited to septic tank absorption fields because of wetness and the slow permeability.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or some other suitable material. Side ditches and culverts provide adequate drainage for roads and streets and reduce damage caused by the shrinking and swelling of the soil, wetness, and frost action.

This soil is in capability subclass IIIe. A woodland ordination symbol was not assigned.

**27D—Sampsel silty clay loam, 9 to 14 percent slopes.** This is a strongly sloping, poorly drained soil on uplands. The areas are irregular in shape and range from about 10 to 25 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 6 inches thick. The subsurface layer is very dark grayish brown, firm silty clay loam about 7 inches thick. The subsoil is 52 or more inches thick. The upper part is very dark grayish brown, firm silty clay loam; the middle part is olive gray, mottled, firm silty clay; and the lower part is olive, mottled, very firm silty clay. In some areas the surface and subsurface layers combined are less than 10 inches thick.

Permeability is slow, and surface runoff is rapid. The available water capacity is moderate. The surface layer varies widely in reaction because lime has been applied in places. The subsoil is slightly acid. Natural fertility is medium, and the content of organic matter is moderate. The shrink-swell potential is high. A seasonal high water table ranges from near the surface to a depth of 1 1/2 feet during winter and spring.

In most areas, this soil is used for pasture. It is suited to grasses and legumes for pasture and hay. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to corn, soybeans, and small grains if close-growing pasture or hay crops are included in the cropping system. Erosion is a severe hazard if this soil is continuously used for row crops.

This soil is suited to building site development and to some systems for onsite waste disposal, but slope, the high shrink-swell potential, and wetness are limitations. Land shaping is necessary, or dwellings can be designed to accommodate the slope. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Drainage tiles around footings and foundations help prevent damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent damage caused by frost action and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. Some leveling is necessary because of the slope. This soil generally is not suited to septic tank absorption fields because of wetness and the slow permeability.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or some other suitable material. Side ditches and culverts provide adequate drainage for roads and reduce damage caused by the shrinking and swelling of the soil, wetness, and frost action.

This soil is in capability subclass IVe. A woodland ordination symbol was not assigned.

**28B—Smileyville silt loam, 2 to 6 percent slopes.**

This is a gently sloping, poorly drained soil on convex ridgetops and on concave side slopes. The areas of this soil are irregularly shaped and range from about 5 to 70 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer is grayish brown, very friable silt loam about 5 inches thick. The subsoil is about 49 inches thick. The upper part is dark grayish brown and grayish brown, mottled, firm and very firm silty clay; and the lower part is grayish brown and gray, mottled, firm silty clay loam.

Included with this soil in mapping are small areas of the nearly level, poorly drained Edina soils in positions on the landscape higher than those of the Smileyville soil. Also included are the well drained Menfro soils and the moderately well drained Armstrong soils on the lower part of side slopes. The included soils make up less than 10 percent of the map unit.

Permeability is slow, and surface runoff is medium. The available water capacity is high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil is medium acid or strongly acid. Natural fertility is high, and the content of organic matter is moderate. The shrink-swell potential is high. A seasonal high water table is at a depth of 1/2 foot to 1 1/2 feet during winter and spring.

In most areas, this soil is cultivated. It is suited to corn, soybeans, and small grains. Cultivation increases the hazard of erosion. Conservation tillage, which leaves crop residue on the surface, winter cover crops, and terraces help prevent excessive erosion. Crop residue returned to the surface and green manure crops also help control erosion.

This soil is suited to hay and pasture. Grasses and legumes effectively control erosion. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to building site development and to some systems for onsite waste disposal, but the high shrink-swell potential and wetness are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Drainage tiles around footings and foundations help prevent damage caused by excessive wetness. Land shaping generally is necessary on sites for small commercial buildings because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for



sidewalks and driveways help prevent damage caused by frost action and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. Land leveling is necessary because of the slope. This soil generally is not suited to septic tank absorption fields because of wetness and the slow permeability.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or some other suitable material. Roads should be constructed on raised, well-compacted fill material. Side ditches and culverts provide adequate drainage and reduce damage caused by the shrinking and swelling of the soil, wetness, and frost action.

This soil is in capability subclass IIe. A woodland ordination symbol was not assigned.

**29B—Vigar loam, 2 to 5 percent slopes.** This is a gently sloping, moderately well drained soil on the lower part of upland slopes or on toe slopes. The areas of this soil are irregularly shaped but generally are elongated. They range from about 10 to 25 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 6 inches thick. The subsurface layer is very dark grayish brown, friable loam about 6 inches thick. The subsoil is about 50 inches thick. The upper part is very dark grayish brown, friable clay loam, and the lower part is grayish brown, mottled, firm clay loam.

Included with this soil in mapping are small areas of the poorly drained Blackoar soils in positions on the landscape lower than those of the Vigar soil and the well drained Lindley soils in higher positions on the landscape. The included soils make up less than 10 percent of the map unit.

Permeability is moderately slow, and surface runoff is medium. The available water capacity is high. The surface layer varies in reaction, and the subsoil is slightly acid. Natural fertility is high, and the content of organic matter is moderate. The shrink-swell potential is moderate. A seasonal high water table is at a depth of 2 to 3 feet during winter and spring.

In most areas, this soil is cultivated. It is suited to corn, soybeans, and small grains. Planting on the contour helps reduce erosion. Conservation tillage, which leaves crop residue on the surface, and winter cover crops also help control erosion. Diversions at the base of upland slopes help control runoff from the uplands.

This soil is suited to pasture and hay. Grasses and legumes effectively control erosion on this soil. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to building site development and to some systems for onsite waste disposal, but the shrink-swell potential and wetness are limitations. Damage to dwellings and small commercial buildings caused by the

shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Drainage tiles around footings and foundations help prevent damage caused by excessive wetness. Land shaping generally is necessary on sites for small commercial buildings because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent damage caused by frost action and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. Sealing the bottom is necessary to prevent contamination of the ground water. This soil generally is not suited to septic tank absorption fields because of the moderately slow permeability and wetness.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or some other suitable material. Roads should be constructed on raised, well-compacted fill material. Side ditches and culverts provide adequate drainage for roads and reduce damage caused by the shrinking and swelling of the soil, frost action, and wetness.

This soil is in capability subclass IIe. A woodland ordination symbol was not assigned.

**30B—Weller silt loam, 2 to 5 percent slopes.** This is a gently sloping, moderately well drained soil on convex ridgetops. The areas of this soil are irregularly shaped and range from about 10 to 20 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 6 inches thick. The subsurface layer is brown, very friable silt loam about 8 inches thick. The subsoil is about 38 inches thick. The upper part is yellowish brown, mottled, firm silty clay loam; the middle part is dark yellowish brown, mottled, firm silty clay; and the lower part is mottled, dark yellowish brown, grayish brown, and strong brown, friable silty clay loam. The substratum is mottled, grayish brown and yellowish brown, very friable silt loam to a depth of 63 inches.

Included with this soil in mapping are small areas of the more sloping Winfield and Menfro soils. These soils have less clay throughout and are not so gray as the Weller soil. The included soils make up less than 10 percent of the map unit.

Permeability is slow, and surface runoff is medium. The available water capacity is high. The surface layer varies widely in reaction because lime has been applied in places. The subsoil is strongly acid or very strongly acid. Natural fertility is high, and the content of organic matter is moderately low. The shrink-swell potential is high. A seasonal high water table is at a depth of 2 to 4 feet during winter and spring.

In most areas, this soil is used for cultivated crops, pasture, and hay. This soil is suited to corn, soybeans, and small grains. Cultivation increases the hazard of

erosion. Conservation tillage, which leaves crop residue on the surface, contour farming, and winter cover crops help prevent excessive erosion. Returning crop residue to the surface and regularly adding other organic matter help improve fertility, reduce crusting, and increase water infiltration.

This soil is suited to hay and pasture. Grasses and legumes effectively control erosion. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees. Windthrow is a hazard, however, and planting large stock may be necessary to achieve a satisfactory survival rate. Frequent, light thinning reduces the hazard of windthrow.

This soil is suited to building site development and to onsite waste disposal systems, but the high shrink-swell potential and wetness are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Drainage tiles around footings and foundations help prevent damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent damage caused by frost action and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. The soil generally is not suited to septic tank absorption fields because of the slow permeability and wetness.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or some other suitable material. Side ditches and culverts provide adequate drainage for roads and reduce damage caused by the shrinking and swelling of the soil, frost action, and wetness.

This soil is in capability subclass IIIe. The woodland ordination symbol is 4c.

**31C2—Winfield silt loam, 5 to 9 percent slopes, eroded.** This is a moderately sloping, moderately well drained soil on ridgetops and side slopes. The areas of this soil are irregularly shaped and range from about 10 to 80 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 6 inches thick. The subsurface layer is dark yellowish brown, friable silt loam about 3 inches thick. The subsoil is about 38 inches thick. The upper part is dark brown, firm silty clay loam; and the lower part is dark yellowish brown, mottled, firm silty clay loam. The substratum is dark yellowish brown, mottled, friable silt loam to a depth of 68 inches. In some places, the surface layer is silty clay loam, and the lower part of the

subsoil does not have gray mottles. In some places, the slope is less than 5 percent.

Permeability is moderate, and surface runoff is medium. The available water capacity is high. The surface layer varies widely in reaction because lime has been applied in some places. The subsoil is strongly acid or very strongly acid. Natural fertility is medium, and the content of organic matter is moderately low. The shrink-swell potential is moderate. A seasonal high water table is at a depth of 2 1/2 to 4 feet during winter and spring.

In most areas, this soil is used for cultivated crops, hay, and pasture. It is suited to corn, soybeans, and small grains. Cultivation increases the hazard of erosion. Uniform slopes can be terraced and farmed on the contour. Conservation tillage, which leaves crop residue on the surface, strip cropping, and winter cover crops help prevent excessive erosion. Crop residue returned to the surface and green manure crops also help control erosion.

This soil is suited to hay and pasture. Grasses and legumes effectively control erosion. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff. Proper stocking, rotation grazing, and deferment of grazing during wet periods help maintain or improve the condition of the pasture and soil.

This soil is suited to trees although there are few stands. The limitations are slight. This soil is suitable for fruit trees and vineyards.

This soil is suited to building site development and to some systems for onsite waste disposal, but the shrink-swell potential and wetness are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. Drainage tiles around basement walls help prevent damage caused by excessive wetness. Land shaping is necessary on sites for small commercial buildings because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent damage caused by frost action and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons. Leveling the site and sealing the bottom may be necessary to prevent contamination of the ground water. This soil generally is not suited to septic tank absorption fields because of wetness.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or some other suitable material. Side ditches and culverts provide adequate drainage for roads and help reduce damage caused by frost action and the shrinking and swelling of the soil.

This soil is in capability subclass IIIe. The woodland ordination symbol is 3o.

**31D2—Winfield silt loam, 9 to 14 percent slopes, eroded.** This is a strongly sloping, moderately well drained soil on side slopes. The areas of this soil are irregularly shaped and range from about 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 4 inches thick. The subsurface layer is yellowish brown and dark brown, friable silt loam about 6 inches thick. The subsoil is about 38 inches thick. The upper part is yellowish brown, friable silt loam; the middle part is yellowish brown and dark yellowish brown, mottled, firm silty clay loam; and the lower part is multicolored, firm silty clay loam. The substratum is light brownish gray, mottled, very firm silt loam to a depth of 62 inches. In some areas, the surface layer is silty clay loam. In a few areas, there are no gray mottles in the lower part of the subsoil.

Permeability is moderate, and surface runoff is rapid. The available water capacity is high. The subsoil is strongly acid or very strongly acid. Natural fertility is medium, and the content of organic matter is moderately low. The shrink-swell potential is moderate. A seasonal high water table is at a depth of 2 1/2 to 4 feet during winter and spring.

In most areas, this soil is used for cultivated crops, hay, and pasture. This soil is suited to corn and soybeans. If this soil is cultivated, erosion is a severe hazard. Terraces, grassed waterways, conservation tillage, which leaves crop residue on the surface, stripcropping, and an appropriate crop rotation help prevent excessive erosion. Terraces should have a steep grassed back slope. Gullying is a serious problem, and waterways should be carefully designed and maintained. Crop residue returned to the surface and green manure crops help improve fertility and increase water infiltration.

This soil is suited to hay and pasture. Grasses and legumes effectively control erosion. Overgrazing or grazing when the soil is wet compacts the surface and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, and deferment of grazing help maintain or improve the condition of the pasture and soil.

This soil is suited to trees, and in some areas there are stands of native hardwoods. The limitations are slight.

This soil is suited to building site development and to some systems for onsite waste disposal, but the shrink-swell potential, slope, and wetness are limitations. Damage to dwellings and small commercial buildings caused by the shrinking and swelling of the soil can be prevented by an appropriate design. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or

gravel. Drainage tiles around basement walls help prevent damage caused by wetness. Land shaping generally is necessary, or dwellings can be designed to accommodate the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help prevent damage caused by wetness and the shrinking and swelling of the soil.

This soil is suitable for sewage lagoons if the site can be leveled. Sealing the bottom of the lagoon may be necessary to prevent contamination of the ground water. This soil generally is not suited to septic tank absorption fields because of wetness.

This soil is not strong enough to support vehicular traffic, but the base material can be strengthened with crushed rock or some other suitable material. Side ditches and culverts provide adequate drainage for roads and reduce damage caused by frost action and the shrinking and swelling of the soil. Land shaping may be necessary to reduce the slope.

This soil is in capability subclass IIe. The woodland ordination symbol is 3o.

**32—Pits-Orthents complex.** This complex consists of deep excavations and piles of soil, rock fragments, and other debris. Some of the excavated material is used to build dams, roads, and other structures. Excavated limestone and shale are used in manufacturing cement. Pits make up about 20 to 50 percent of each mapped area, and Orthents make up 50 to 80 percent. The mapped areas range from 15 to 150 acres in size.

Typically, Pits are quarries or open excavations from which soil material and the underlying rock have been removed. The excavations are 50 to 150 feet deep. Most pits have a drainage outlet.

Pits generally are not suited to any form of cultivation, building site development, or recreation use. Onsite investigation is necessary to determine their suitability for any intended use.

Typically, Orthents are stockpiled material from pits. The material consists of gravel, clay, silt, stones, and boulders.

Permeability of Orthents generally is moderate or moderately slow. The available water capacity is estimated to be moderate. Acidity, drainage, natural fertility, and runoff are variable. The content of organic matter generally is low.

Orthents are mostly idle and are reverting to native vegetation of cottonwood, sycamore, and willow. These areas can be used as habitat for wildlife. In some places, the soil is being stockpiled for reclamation.

This unit was not assigned to a capability class or to a woodland suitability group.

# Prime Farmland

In this section, prime farmland is defined and discussed, and the prime farmland soils in Marion and Ralls Counties are listed.

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, feed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. The moisture supply, of course, must be adequate, and the growing season has to be sufficiently long. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources, and farming these soils results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, or woodland, or they may be in other uses. They either are used for producing food or fiber or are available for these uses. Urban or built-up land and water areas cannot be considered prime farmland. Urban or built-up land is defined as any contiguous unit of land 10 acres or more in size that is used for nonfarm uses including housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water control structures.

Prime farmland soils usually get an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not subject to frequent flooding during the growing season. The slope ranges mainly from 0 to 5 percent.

Soils that have a high water table or are subject to flooding may qualify as prime farmland soils if the

limitations are overcome by drainage or flood control. Onsite evaluation is necessary to determine the effectiveness of corrective measures. More information on the criteria for prime farmland soils can be obtained at the local office of the Soil Conservation Service or the Missouri University Extension Service.

About 283,000 acres, or nearly 48 percent of the survey area, is prime farmland. Approximately 184,000 acres of this is used as cropland. Areas of prime farmland are scattered throughout the survey area, and most are in associations 1, 4, and 6 on the general soil map.

A recent trend in land use has been the conversion of some prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are wet, more erodible, droughty, or difficult to cultivate and less productive than prime farmland.

The following map units, or soils, make up prime farmland in Marion and Ralls Counties. On some soils included in the list, appropriate measures have been applied to overcome a hazard or limitation, such as flooding or wetness. The location of each map unit is shown on the detailed soil maps at the back of this publication. The extent of each unit is given in table 4. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

- 4 Belknap silt loam (where drained)
- 5 Blackoak silt loam (where drained)
- 6 Blase silty clay
- 7B Calwoods silt loam, 2 to 5 percent slopes (where drained)
- 8 Carlow silty clay (where drained)
- 9 Cedargap silt loam (where flooding occurs no more than once in 2 years during the growing season)
- 10 Chariton silt loam (where drained)
- 11 Chequest silty clay loam (where drained)
- 12 Edina silt loam (where drained)
- 13 Fatima silt loam (where protected from flooding)
- 14B Gifford silt loam, 2 to 5 percent slopes (where drained)
- 19 Landes fine sandy loam
- 22B Marion silt loam, 2 to 5 percent slopes
- 23B Menfro silt loam, 2 to 5 percent slopes

24B2	Mexico silty clay loam, 2 to 5 percent slopes, eroded (where drained)	28B	Smileyville silt loam, 2 to 6 percent slopes (where drained)
25	Moniteau silt loam (where drained)	29B	Vigar loam, 2 to 5 percent slopes
26	Putnam silt loam (where drained)	30B	Weller silt loam, 2 to 5 percent slopes

# Use and Management of the Soils

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This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

## Crops and Pasture

Carol A. Bartles, soil scientist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated

yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Marion and Ralls Counties had 424,000 acres of crops and pasture in 1967 (3). Of this, 111,338 acres was used for permanent pasture; 215,600 acres for row crops, mainly corn, soybeans, and grain sorghum; 42,442 acres for close-grown crops, mainly wheat; and 47,229 acres for rotation hay and pasture. The rest was idle cropland and formerly cropped open land.

Most soils in Marion and Ralls Counties are suitable for sustained crop production. About 31,758 acres of potentially good cropland is currently in timber, and about 70,623 acres is used for pasture. The acreage used for crops has been gradually increasing as more land has been converted from pasture, hay, and timber.

Less than half of the cropland in the survey area is adequately treated to meet conservation needs. The inadequately treated cropland is on uplands where farming operations cause excessive erosion. Soil erosion on most cropland can be reduced to a tolerable amount by conservation systems. Marginal land used for row crops should be converted to pasture and hay.

Drainage is needed on one-third of the cropland in Marion and Ralls Counties. The soils are naturally wet because of landscape position, slow permeability, or both. Carlow and Chequest soils are on flood plains and receive runoff and overflow; Putnam soils are on broad, nearly level ridgetops but are very slowly permeable. When these soils receive excess water they stay wet for long periods. Belknap and Blackoak soils also accumulate water. Excess water can be removed from most soils by land grading and field ditches. A few areas have been graded to provide drainage. Land grading eliminates potholes and also provides a suitable grade for the addition of supplemental irrigation.

Soil erosion is the main concern on two-thirds of the land used for crops and pasture. If slope is more than 2 percent, erosion is a hazard. Armstrong, Calwoods, Gorin, Gosport, Goss, Leonard, Menfro, Mexico, Sampsel, Smileyville, Weller, and Winfield soils have



slope of more than 2 percent. Most of the sloping upland soils are subject to erosion if plowed in the fall.

Loss of the surface layer to erosion reduces productivity and leaves the soil in poor tilth. The surface layer contains most of the nutrients and organic matter needed for plant growth. If the surface layer is lost and the subsoil is plowed, good tilth is difficult to maintain. Soil tilth is an important factor in the germination of seeds and the infiltration of water into the soil. An eroded surface puddles and crusts during heavy rainfall because of the poor tilth. The crust is hard when dry and reduces water infiltration and increases runoff. Regular additions of crop residue, manure, and other organic material improve soil tilth.

Control of erosion also minimizes pollution of streams by sediment and improves the quality of water for municipal and recreational uses as well as for fish and wildlife.

Cover crops or permanent vegetation, conservation tillage, terraces, diversions, and other practices are used to control erosion.

Conservation tillage provides a protective surface cover and therefore reduces runoff and increases water infiltration. Conservation tillage methods include the use of tillage equipment that allows much of the crop residue to remain on the soil surface. This equipment could be a chisel plow, field cultivator, or disc. Some planters are designed to operate in the residue, thereby leaving the residue on the surface. A cropping system that keeps a plant cover on the soil for extended periods also reduces erosion and preserves the productive capacity of the soils.

Soil fertility is naturally low in Gorin, Marion, and Moniteau soils. However, these soils respond well to the addition of lime and fertilizer. Nearly all of the upland soils and the soils on the Mississippi River bottom land are naturally acid in the rooting zone. They need applications of ground limestone to reduce the acidity. The application of lime and fertilizer should be based on soil tests, crop needs, and expected yield.

Most of the uneroded soils on the uplands, and most of the soils on stream bottoms and terraces, have a silt loam surface layer which is easily tilled and makes a good seedbed. Generally, the structure of silt loam soils becomes weaker if they are overtilled and compacted. Intense rainfall can cause the surface to crust. Crusting can be a problem on Mexico, Menfro, and Winfield soils, among others.

The silty clay loam or clay loam surface layer of Sampsel, Gosport, and Armstrong soils is difficult to work into a good seedbed. If worked when the soil is wet, the surface layer becomes a mass of hard clods when it dries. These soils must be tilled when surface moisture is at optimum level. Good residue management helps maintain the content of organic matter and improves tilth.

Corn and soybeans are suited to the soils and climate in the survey area and are commonly grown. Grain sorghum is grown in a few areas. Wheat is the most common close-grown crop.

Pasture and hay crops suited to the soils and climate in Marion and Ralls Counties include several legumes, cool-season grasses, and warm-season native grasses. Alfalfa and red clover are the common legumes grown for hay. They are also used in mixtures that include brome grass or orchardgrass. Birdsfoot trefoil can be used alone or in mixtures that include brome grass, orchardgrass, fescue, and bluegrass. Warm-season native grasses adapted to the survey area are big bluestem, indiagrass, and switchgrass. These grasses produce well in summer if properly managed.

Well drained and moderately well drained soils, such as Menfro and Winfield soils, are well suited to alfalfa. Other legumes and all grasses do well on most of the upland soils. Carlow and Chequest soils are flooded occasionally and stay wet for long periods; therefore, they are not suited to all grasses. They are better suited to short-season summer annuals.

The major management problems on most of the pasture are overgrazing and erosion. Grazing should be controlled to protect plants so that they give maximum production. Keeping grasses at a desirable height reduces runoff and helps control erosion.

Supplemental irrigation is used as needed on a few soils on bottom lands. Some areas are not irrigated in some years. Most irrigation is by sprinklers.

Specialty crops grown in the survey area include apples, peaches, and nursery plants. Some of the river hills area of Marion and Ralls Counties is used for orchards. The deep, well drained Menfro soils are well suited to orchards, vineyards, and nurseries.

The latest information on growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

### Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant

diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

### Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

*Capability classes*, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

There are no class I, V, or VIII soils in Marion and Ralls Counties.

*Capability subclasses* are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in table 5.

### Woodland Management and Productivity

James L. Robinson, forester, Soil Conservation Service, helped prepare this section.

Approximately 15 percent of Marion and Ralls Counties is commercial woodland.

Soil properties determine forest cover and tree production. For example, white oak grows well on deep, moist soils, but post oak is more common where the rooting depth is restricted or available moisture is limited. Soil properties that affect growth include soil pH, fertility, drainage, texture, depth, and position on the landscape.

The available water capacity is influenced primarily by the soil texture, rooting depth, and content of coarse fragments in the soil. Deep silt loams such as Menfro soils have a high available water capacity. Soil features such as claypans and bedrock restrict root development and reduce the available water capacity. Little can be done to change these physical limitations, but species that tolerate the conditions can be grown.

Decomposition of the leaf litter on the surface of the soil recycles nutrients. Fire, excessive trampling by livestock, and erosion result in the loss of these nutrients. Forest management must include the prevention of wildfires and protection from overgrazing. The mineral component of the soil is also important. Leached upland soils contain few nutrients, while bottom land soils contain larger amounts of nutrients.



Aspect—the direction a slope faces—affects timber production by influencing the amount of sunlight available, air drainage, soil temperature, and moisture. The best upland timber sites are on north and east aspects.

Most of the woodland in the two counties is in the Winfield-Menfro-Goss and Goss-Gorin-Lindley associations. The major forest type is white oak-red oak-hickory. Black oak, post oak, shingle oak, white ash, sugar maple, American elm, winged elm, black locust, and black walnut are common associates in this forest type. Pure stands of white oak are found in north- and east-facing areas of Lindley and Menfro soils. These soils have the potential to produce high quality trees for veneer. Menfro soils are excellent for black walnut. The Goss soils have moderately low potential for high quality trees. Elm, post oak, and other low quality species are more abundant.

Oak-hickory timber also grows in the Armstrong-Leonard association but generally is of lower quality than in the Winfield-Menfro-Goss and Goss-Gorin-Lindley associations. Shingle oak, post oak, black oak, and hickory make up a larger percentage of the stand. The wooded areas generally are along the draws and on the steeper slopes.

The Fatima-Belknap-Landes association is on the bottom lands of the small rivers and streams. These are productive timber sites with an abundance of black walnut. The common trees are silver maple, cottonwood, ash, elm, and black willow.

The Carlow-Belknap-Chequest association is on the Mississippi River flood plain in riparian strips adjacent to the river, drainage ditches, and wet areas. These sites are productive, with silver maple, ash, cottonwood, box elder, and hackberry dominant.

The Putnam-Mexico association originally was native prairie and consequently has very little woodland. There are a few stands of trees along drainageways and in sloping areas. This association is not a significant source of commercial timber.

Table 6 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol (woodland suitability) for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy

texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: *x*, *w*, *t*, *d*, *c*, *s*, *f*, and *r*.

In table 6, *slight*, *moderate*, and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

*Seedling mortality* ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that few trees may be blown down by strong winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

*Trees to plant* are those that are suited to the soils and to commercial wood production.

## Windbreaks and Environmental Plantings

James L. Robinson, forester, Soil Conservation Service, helped prepare this section.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and tall-growing broadleaf and coniferous trees and shrubs provide the most protection. Windbreaks can significantly reduce the energy required to heat a house in winter, especially in the Putnam-Mexico and Armstrong-Leonard associations.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service, the Missouri Department of Conservation, or the Cooperative Extension Service or from a nursery.

## Recreation

Edward A. Gaskins, biologist, Soil Conservation Service, helped prepare this section.

According to the 1980 Statewide Comprehensive Outdoor Recreation Plan (SCORP), 1,549 acres in Marion County and 12,266 acres in Ralls County have been developed for recreational uses (5). Of this acreage, 83 percent is federal land, 6 percent is state land, 5 percent is privately owned land, 3 percent is municipal land, 2 percent is part of a school, and 1 percent is county land.

The facilities include swimming pools and areas for other water sports, golf courses, ballfields, playgrounds, game courts, campgrounds, picnic areas, nature areas, trails, fairgrounds, historic sites, areas for hunting and fishing, and areas for viewing wildlife.

The state-owned Anderson and Ted Shanks Wildlife Areas, just south of the county line between Ralls and Pike Counties, make up nearly 5,000 acres of land that

is open to the public. The areas are hunted for upland and forest game and for waterfowl. Sites for primitive camping and sites that give access to the river are available. The Elmslie Memorial State Forest near Warren offers fishing, hiking, primitive camping, and hunting. Nature study is featured at the Julian Steyermark Woods and the Ray Memorial Wildlife Area in Marion County. Several federal, state, and municipal access sites on major rivers provide boat launching facilities. City parks at Hannibal and Palmyra and federally owned islands in the Mississippi River are also used for recreation.

In Ralls County, the lake formed by the Clarence Cannon Dam on the Salt River is designed to impound 18,600 acres of water in its normal pool. More than 284 miles of shoreline and nearly 53,000 acres of the surrounding land are available for public use. Eighteen public recreation areas are planned, including more than 800 fully equipped campsites, numerous primitive campsites, 660 picnic sites, 12 boat ramps with 55 individual launching lanes, a major swimming beach, and expansion of Mark Twain State Park. About 3,000,000 people per year, or 28,900 people a day on each weekend of the summer, are expected to use these facilities.

There are about 25 private and semiprivate commercial recreation enterprises in the two-county area, including fishing lakes, swimming pools, gun clubs, boat rentals, charter boat service, marinas, country clubs, historic sites, campgrounds, hunting clubs, and saddle clubs.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and by the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design,

intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

*Camp areas* require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

*Picnic areas* are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

*Playgrounds* require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

*Paths and trails* for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

*Golf fairways* are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

## Wildlife Habitat

Edward A. Gaskins, biologist, Soil Conservation Service, helped prepare this section.

Marion and Ralls Counties are 2 of the 21 counties that make up the Northeast Riverbreaks Zoogeographic Region in Missouri (4). This region, a transition zone between the prairie and the Ozark Border, is characterized by a variety of vegetative types and soils which provide a profusion of edge growth that is

excellent cover for wildlife. Originally, the area was a mixture of woodland and prairie. Today about half of the land area is classified as land suitable for cultivated crops, and the rest is grassland or woodland or is in other uses.

The soils in the Goss-Gorin-Lindley and the Winfield-Menfro-Goss associations are the only soils on which wooded vegetation—trees, shrubs, and brushy growth—is dominant, covering at least half of the acreage. These, together with the timbered soils of the other associations, provide the habitat necessary for woodland wildlife.

The deer population is rated excellent in Marion County and good in Ralls County. In both counties, the small population of wild turkeys is growing and is spreading rapidly into available habitat. Squirrel numbers are rated good. The woodcock population is small.

The furbearer population is rated very good to excellent. Raccoon, muskrat, opossum, coyote, beaver, striped skunk, gray fox, and mink are abundant. There is a small but stable bobcat population.

Soils in the Putnam-Mexico association, the Armstrong-Leonard association, the Fatima-Belknap-Landes association, and the Carlow-Belknap-Chequest association provide most of the habitat for openland wildlife in Marion and Ralls Counties. Soybeans, corn, and wheat are the main crops grown in the two-county area. Nearly all of the original grassland has been converted to cropland, and herbaceous vegetation appears to be the scarcest of the habitat cover types. Increased field size, fall rather than spring tillage, and the loss of wooded travelways extending into areas of cropland have all had a detrimental effect on openland wildlife.

The quail population is poor mainly because of the severe winters of 1977 to 1979 and the loss of habitat. The rabbit population is fair. The resident dove population is good, and it increases during migration periods each year. The pheasant population is small and seems to be quite stable; sightings are reported each year. Songbird populations are good in both counties in all habitat types.

None of the original prairie remains in Marion County, but there are a few remnant tracts of native grassland in Ralls County. The areas support a small flock of prairie chickens. Other prairie wildlife species are almost nonexistent in the survey area.

Nearly all of the remaining wetlands and the waterfowl resting and breeding sites are in areas of the Carlow-Belknap-Chequest association along the Mississippi River. Such bottom lands are almost nonexistent in Ralls County. However, the Clarence Cannon National Refuge and the state-owned Ted Shanks Wildlife Area in Pike County both attract waterfowl; consequently, Ralls County has a good waterfowl population. Marion County, in contrast, is rated poor in total number of birds. There

is a good resident wood duck population in wooded areas along several of the major rivers.

An excellent bald eagle population is reported in Ralls County along the Mississippi River.

Rivers, streams, lakes, and farm ponds provide opportunities for fishing. There are 127 miles of perennial streams in Marion County and 59 miles in Ralls County. The Mississippi River borders the survey area for 34 miles. It is heavily fished. Commercial fishermen take mainly carp, buffalo, catfish, and sturgeon. Fish taken below the dams are mainly white bass, walleye, sauger, and drum. In the backwaters there are channel catfish, bass, suckers, paddlefish, bluegill, river herring, and crappie.

Other good fishing rivers are the North Fabius, South Fabius, North, South, and Salt Rivers. Spencer Creek in Ralls County is also heavily fished. Principal stream fishes include crappie, walleye, sauger, drum, carp, bluegill, and green sunfish. Channel and flathead catfish and largemouth, smallmouth, and white bass also are abundant.

Impoundment fishing is provided by Route J Lake in Ralls County and the shallow Bay de Charles in Marion County. The Clarence Cannon Dam, impounding 18,600 acres of water in Ralls and Monroe Counties, offers area anglers and visitors many opportunities for flatwater fishing. There are about 2,500 farm ponds and small lakes in the survey area. Most of them have been stocked with a combination of largemouth bass, channel catfish, and bluegill.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind

of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

*Grain and seed crops* are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, millet, soybeans, and milo.

*Grasses and legumes* are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are bluegrass, switchgrass, orchardgrass, indiangrass, clover, alfalfa, trefoil, and crownvetch.

*Wild herbaceous plants* are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, pokeweed, foxtail, croton, and partridgepea.

*Hardwood trees* and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, wild plum, sumac, persimmon, and sassafras. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are autumn-olive, crabapple, Amur honeysuckle, and hazelnut.

*Coniferous plants* furnish winter cover, browse, and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

*Wetland plants* are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil

properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cutgrass, cattail, rushes, sedges, and buttonbush.

*Shallow water areas* have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

*Habitat for openland wildlife* consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, red fox, woodchuck, and mourning dove.

*Habitat for woodland wildlife* consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

*Habitat for wetland wildlife* consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, muskrat, mink, and beaver.

## Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

*Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.*

*The information is not site specific and does not eliminate the need for onsite investigation of the soils or*

*for testing and analysis by personnel experienced in the design and construction of engineering works.*

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations must be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

## Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that



special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

*Shallow excavations* are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

*Dwellings and small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, and shrink-swell potential can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

*Local roads and streets* have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

*Lawns and landscaping* require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

## Sanitary Facilities

Table 11 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

*Septic tank absorption fields* are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

*Sewage lagoons* are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

*Sanitary landfills* are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

*Daily cover for landfill* is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer

generally has the best workability, more organic matter, and the best potential for plant growth. Material from the surface layer, therefore, should be stockpiled for use as the final cover.

### Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good*, *fair*, or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

*Roadfill* is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

*Sand and gravel* are natural aggregates suitable for commercial use with a minimum of processing. Sand and

gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

*Topsoil* is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

## Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree

and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

*Pond reservoir areas* hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

*Embankments, dikes, and levees* are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

*Drainage* is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts,



sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

*Irrigation* is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

*Terraces and diversions* are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and

depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

*Grassed waterways* are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

# Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

## Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

*Depth* to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

*Texture* is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

*Classification* of the soils is determined according to the Unified soil classification system (2) and the system adopted by the American Association of State Highway and Transportation Officials (1).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

*Rock fragments* larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

*Percentage (of soil particles) passing designated sieves* is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

*Liquid limit* and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The

estimates are based on test data from the survey area or from nearby areas and on field examination.

## Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

*Clay* as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

*Moist bulk density* is the weight of soil (oven-dry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

*Permeability* refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

*Available water capacity* refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water

capacity is not an estimate of the quantity of water actually available to plants at any given time.

*Soil reaction* is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

*Salinity* is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

*Shrink-swell potential* is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

*Erosion factor K* indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

*Erosion factor T* is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

*Wind erodibility groups* are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
- 4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.
4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to wind erosion.

*Organic matter* is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

## Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

*Hydrologic soil groups* are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

*Flooding*, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay

deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

*High water table* (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An *artesian* water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

*Depth to bedrock* is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or

fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

*Potential frost action* is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

*Risk of corrosion* pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

# Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (9). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 17 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

**ORDER.** Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

**SUBORDER.** Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udalf (*Ud*, meaning humid, plus *alf*, from Alfisol).

**GREAT GROUP.** Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludalf (*Hapl*, meaning minimal horizonation, plus *udalf*, the suborder of the Alfisols that have an udic moisture regime).

**SUBGROUP.** Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludalfs.

**FAMILY.** Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties

and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, mesic Typic Hapludalfs.

**SERIES.** The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

## Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (8). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (9). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

## Armstrong Series

The Armstrong series consists of deep, moderately well drained, slowly permeable soils on uplands. Armstrong soils were derived from paleosols that formed in glacial till. The slopes range from 5 to 14 percent.

Armstrong soils commonly are adjacent to Leonard soils. Leonard soils are upslope from Armstrong soils. They have less sand in the upper 30 inches.

Typical pedon of Armstrong loam, 9 to 14 percent slopes, eroded, 100 feet south and 1,400 feet east of the center of sec. 8, T. 54 N., R. 7 W., in Ralls County:



Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; very friable; common very fine roots; common very fine pores; slightly acid; abrupt smooth boundary.

2Bt1—6 to 13 inches; dark brown (7.5YR 4/4) clay loam; common fine prominent red (2.5YR 4/6) mottles; weak fine subangular blocky structure; firm; few fine roots; many prominent clay films on faces of peds; medium acid; gradual smooth boundary.

2Bt2—13 to 20 inches; strong brown (7.5YR 5/6) clay loam; many fine distinct yellowish red (5YR 5/6) mottles and common fine prominent light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; very firm; few very fine roots; few very fine pores; common prominent clay films on faces of peds; medium acid; gradual smooth boundary.

2Bt3—20 to 43 inches; strong brown (7.5YR 5/6) clay loam; few fine distinct yellowish red (5YR 5/6) mottles and few fine prominent light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; few very fine roots; few very fine pores; few prominent clay films on faces of peds; medium acid; clear smooth boundary.

2Bt4—43 to 62 inches; strong brown (7.5YR 5/6) clay loam; common medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few fine roots; few prominent clay films on faces of peds; few black (10YR 2/1) oxide stains; medium acid.

The solum is 45 to more than 60 inches thick.

The A horizon has hue of 10YR, value of 3, and chroma of 1 or 2. The Ap horizon is mainly loam, but the range includes clay loam. The 2Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 through 6. It has some mottles that have chroma of 1 or 2. There are few very fine white chert fragments throughout the 2Bt horizon. The 2Bt horizon ranges from very strongly acid to medium acid.

## Belknap Series

The Belknap series consists of deep, somewhat poorly drained, moderately slowly permeable soils on bottom lands. Belknap soils formed in silty alluvium. The slopes range from 0 to 2 percent.

Belknap soils commonly are adjacent to Carlow and Chequest soils. Carlow and Chequest soils have a mollic epipedon and are fine textured. They are in lower positions on the landscape.

Typical pedon of Belknap silt loam, approximately 150 feet west of Route A, 400 feet north and 1,500 feet west of the southeast corner of sec. 24, T. 59 N., R. 7 W., in Marion County:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; friable; few very fine roots; few very fine pores and few fine pores; neutral; clear smooth boundary.

Cg1—7 to 12 inches; stratified dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silt loam; many fine distinct dark yellowish brown (10YR 4/4) mottles; moderate fine granular structure; friable; few very fine roots; common very fine pores and few fine pores; strongly acid; clear smooth boundary.

Cg2—12 to 27 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silt loam; many fine distinct dark yellowish brown (10YR 4/4) mottles; moderate fine granular structure; friable; few very fine roots; common very fine pores and few fine pores; strongly acid; clear smooth boundary.

Cg3—27 to 36 inches; grayish brown (10YR 5/2) silt loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate fine granular structure; friable; few very fine roots; common very fine pores and few fine pores; common fine oxide concretions; strongly acid; clear smooth boundary.

Cg4—36 to 68 inches; light brownish gray (10YR 6/2) silt loam; many medium distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; few very fine roots; common very fine pores and few fine pores; strongly acid.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2. The C horizon has hue of 10YR, value of 4 through 6, chroma of 1 through 3, and mottles of higher chroma. The C horizon is medium acid to very strongly acid.

## Blackoar Series

The Blackoar series consists of deep, poorly drained, moderately permeable soils on bottom lands. Blackoar soils formed in recent silty alluvium. The slopes range from 0 to 2 percent.

Blackoar soils commonly are adjacent to Belknap and Chequest soils. Belknap soils do not have a mollic epipedon and are in similar positions on the landscape. Chequest soils are finer in texture than the Blackoar soils and are in lower positions.

Typical pedon of Blackoar silt loam, 100 feet east and 550 feet north of the southwest corner of sec. 15, T. 58 N., R. 5 W., in Marion County:

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, gray (10YR 5/2) dry; moderate fine granular structure; very friable; few very fine roots; common very fine pores; neutral; abrupt smooth boundary.

A—10 to 17 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; few fine distinct dark brown



(10YR 4/3) mottles; moderate fine granular structure; very friable; few very fine roots; common very fine pores and few fine pores; neutral; clear smooth boundary.

Bg1—17 to 34 inches; gray (10YR 5/1) silt loam; common fine distinct dark yellowish brown (10YR 4/4) mottles and fine prominent yellowish brown (10YR 3/6) mottles; weak fine subangular blocky structure; friable; few very fine roots; common fine pores and few very fine pores; few prominent clay films on faces of peds; neutral; clear smooth boundary.

Bg2—34 to 65 inches; dark gray (10YR 4/1) silt loam; common medium distinct dark brown (10YR 4/3) mottles; weak medium subangular blocky structure; firm; few fine pores; slightly acid.

The solum is 40 to more than 60 inches thick.

The A horizon has hue of 10YR, value of 3, and chroma of 1 or 2. The Bg horizon has hue of 10YR or 5Y, value of 4 or 5, and chroma of 1. There are higher chroma mottles in the lower horizons. The Bg horizon is neutral or slightly acid.

## Blase Series

The Blase series consists of deep, somewhat poorly drained soils on terraces. Blase soils are slowly permeable in the upper part and moderately permeable in the lower part. They formed in clayey alluvium over loamy and silty alluvium. The slopes range from 0 to 2 percent.

Blase soils commonly are adjacent to Carlow and Chequest soils. Carlow and Chequest soils are fine textured throughout and are in lower positions on the landscape.

Typical pedon of Blase silty clay, 900 feet south and 200 feet east of the northwest corner of sec. 10, T. 59 W., R. 5 W., in Marion County:

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; few very fine roots; common very fine pores; slightly acid; clear smooth boundary.

A—9 to 22 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine angular and subangular blocky structure; firm; few very fine roots; many very fine pores and few fine pores; slightly acid; clear smooth boundary.

Bw1—22 to 31 inches; dark grayish brown (10YR 4/2) silty clay; few fine distinct dark brown (10YR 4/3) mottles; weak fine subangular blocky structure; firm; few very fine roots; many very fine pores and few fine pores; medium acid; clear smooth boundary.

2Bw2—31 to 35 inches; dark grayish brown (10YR 4/2) silt loam; common medium faint dark brown (10YR 4/3) mottles; weak medium subangular blocky structure; firm; few very fine roots; common very fine

pores and few fine pores; slightly acid; abrupt smooth boundary.

2C—35 to 65 inches; brown (10YR 5/3) silt loam; massive; very friable; few very fine roots; common very fine pores and few fine pores; neutral.

The solum is 30 to 40 inches thick.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly silty clay, but the range includes silty clay loam. The Bw horizon has hue of 10YR, value of 3 through 5, and chroma of 2. It is silty clay or silty clay loam. The 2Bw2 horizon has hue of 10YR, value of 4 or 5, and chroma of 2. It is silt loam, loam, or fine sandy loam. There are higher chroma mottles throughout the B horizon. The B horizon is medium acid or slightly acid.

## Calwoods Series

The Calwoods series consists of deep, somewhat poorly drained, very slowly permeable soils on uplands. Calwoods soils formed in loess and silty sediment or in loess, silty sediment, and glacial till. The slopes range from 2 to 5 percent.

Calwoods soils are similar to Mexico soils and commonly are adjacent to Gorin and Putnam soils. Gorin soils are steeper than Calwoods soils and have higher chroma in the solum. Putnam soils have a thick E horizon and an abrupt textural change between the A and B horizons. They are on wide divides. Mexico soils have a dark surface layer.

Typical pedon of Calwoods silt loam, 2 to 5 percent slopes, 290 feet east and 250 feet north of the center of sec. 23, T. 55 N., R. 7 W., in Ralls County:

A—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate very fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

E—6 to 8 inches; light brownish gray (10YR 6/2) silt loam; moderate very fine granular structure; friable; common fine roots; medium acid; clear smooth boundary.

BE—8 to 13 inches; yellowish brown (10YR 5/4) silty clay loam; few fine distinct light brownish gray (10YR 6/2) and strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm; common fine roots; common prominent clay films on faces of peds; very strongly acid; clear smooth boundary.

Btg1—13 to 19 inches; light brownish gray (10YR 6/2) silty clay; many fine prominent yellowish red (5YR 5/6) mottles; moderate medium subangular blocky structure; very firm; few fine roots; many prominent clay films on faces of peds; very strongly acid; clear smooth boundary.

Btg2—19 to 27 inches; grayish brown (2.5Y 5/2) silty clay; common medium prominent strong brown

(7.5YR 5/6) mottles; moderate medium subangular blocky structure; very firm; few fine roots; many prominent clay films on faces of peds; very strongly acid; clear smooth boundary.

2Btg3—27 to 42 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; very firm; common prominent clay films on faces of peds; some fine sand; very strongly acid; clear smooth boundary.

Btg4—42 to 54 inches; grayish brown (10YR 5/2) clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure; very firm; many prominent clay films in old root channels; black (10YR 2/1) stains on faces of some peds; strongly acid; clear smooth boundary.

C—54 to 62 inches; light brownish gray (2.5Y 6/2) and dark yellowish brown (10YR 4/4) clay loam; massive; very firm; medium acid.

The solum is 35 to 60 inches thick.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is dominantly silt loam, but the range includes silty clay loam. The Bt horizon has hue of 2.5Y or 10YR, value of 4 through 6, and chroma of 2 or 3. The B horizon is strongly acid or very strongly acid. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2. There are higher chroma mottles throughout the soil.

## Carlow Series

The Carlow series consists of deep, poorly drained, very slowly permeable soils on bottom lands. Carlow soils formed in clayey alluvium in slack-water areas. The slopes range from 0 to 1 percent.

Carlow soils commonly are adjacent to Blase and Chequest soils. Blase soils are fine over loamy in texture and are in slightly higher positions on the landscape. Chequest soils have less clay and are at slightly higher elevations.

Typical pedon of Carlow silty clay, 110 feet north and 100 feet west of the southeast corner of sec. 29, T. 59 N., R. 5 W., in Marion County:

Ap—0 to 6 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; few fine distinct dark brown (7.5YR 4/4) mottles; moderate fine granular structure; friable; common fine and very fine vertical roots; few very fine pores; medium acid; abrupt smooth boundary.

A—6 to 12 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; many fine distinct dark brown (10YR 3/3) mottles; weak medium prismatic structure parting to weak fine subangular blocky; firm; common fine and very fine roots; few very fine pores; medium acid; clear smooth boundary.

Bg1—12 to 18 inches; dark gray (10YR 4/1) silty clay; few fine distinct dark brown (10YR 3/3) mottles; weak medium prismatic structure parting to weak fine subangular blocky; firm; common fine and very fine roots; few very fine pores; medium acid; clear smooth boundary.

Bg2—18 to 25 inches; dark gray (10YR 4/1) silty clay; common fine and medium distinct dark brown (7.5YR 4/4) mottles; weak medium prismatic structure parting to moderate fine and medium subangular blocky; very firm; common fine and very fine roots; few very fine pores; medium acid; clear smooth boundary.

Bg3—25 to 47 inches; dark gray (10YR 4/1) silty clay; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium prismatic structure parting to moderate fine subangular and angular blocky; very firm; few very fine roots; few very fine pores; common slickensides; medium acid; clear smooth boundary.

Cg—47 to 65 inches; dark gray (5Y 4/1) silty clay; common fine distinct dark brown (10YR 3/3) and few medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium prismatic structure parting to moderate medium angular and subangular blocky; very firm; few very fine pores; common slickensides; medium acid.

The solum is 30 to 55 inches thick.

The A horizon has hue of 10YR, value of 3, and chroma of 1 or 2. It is dominantly silty clay, but the range includes silty clay loam. The Bg horizon has hue of 10YR or 5Y, value of 4 or 5, and chroma of 1. It is silty clay or clay. The Bg horizon generally is medium acid, but in some places, it is strongly acid. The Cg horizon has hue of 10YR or 5Y, value of 4 or 5, and chroma of 1. There are mottles of higher chroma throughout the soil.

## Cedargap Series

The Cedargap series consists of deep, well drained, moderately rapidly permeable soils on bottom lands. Cedargap soils formed in silty alluvium that had a high content of chert fragments. The slopes range from 0 to 2 percent.

Cedargap soils commonly are adjacent to Goss soils and in some places are adjacent to Winfield soils. Goss and Winfield soils are on upland side slopes. Goss soils are cherty throughout. Winfield soils do not have sand or chert.

Typical pedon of Cedargap silt loam, 600 feet east and 700 feet south of the northwest corner of sec. 33, T. 56 N., R. 3 W., in Ralls County:

A1—0 to 8 inches; dark brown (10YR 3/3) silt loam, grayish brown (10YR 5/2) dry; moderate fine

granular structure; friable; common very fine roots; few very fine pores; neutral; clear smooth boundary.

A2—8 to 17 inches; dark brown (10YR 3/3) silt loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; firm; few very fine roots; few very fine pores; neutral; clear smooth boundary.

A3—17 to 38 inches; dark brown (10YR 3/3) extremely cherty loam, grayish brown (10YR 5/2) dry; few fine distinct strong brown (7.5YR 5/6) mottles; moderate fine and medium structure; firm; 75 percent chert fragments; few medium roots; slightly acid; clear smooth boundary.

C—38 to 68 inches; dark brown (10YR 4/3, 4/4) extremely cherty clay loam; massive; firm; 80 percent chert fragments; few medium roots; slightly acid.

The solum is 24 to 44 inches thick. The soil is neutral or slightly acid.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 through 3. The C horizon has hue of 10YR, value of 2 through 5, and chroma of 2 through 4. The chert content ranges from 0 to 50 percent in the upper 20 inches of the soil and from 50 to 90 percent below a depth of 20 inches.

## Chariton Series

The Chariton series consists of deep, poorly drained, slowly permeable soils on stream terraces. Chariton soils formed in loess or in loess and alluvium. The slopes range from 0 to 2 percent.

Chariton soils are similar to Putnam soils and commonly are adjacent to Gifford soils. Gifford soils do not have an E horizon and are in lower positions on the landscape. Putnam soils are more acid and have less sand in the lower part of the profile.

Typical pedon of Chariton silt loam, 2,250 feet east and 2,550 feet south of the northwest corner of sec. 19, T. 59 N., R. 6 W., in Marion County:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; very friable; few very fine roots; few very fine pores; slightly acid; abrupt smooth boundary.

E—9 to 16 inches; gray (10YR 5/1) silt loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium platy and moderate fine granular structure; friable; few very fine roots; few very fine pores; strongly acid; abrupt smooth boundary.

Btg1—16 to 22 inches; dark grayish brown (10YR 4/2) silty clay; common fine distinct yellowish brown (10YR 5/6) and few fine distinct dark brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; very firm; few very fine roots; few very fine

pores; many prominent clay films on faces of peds; strongly acid; clear smooth boundary.

Btg2—22 to 32 inches; dark grayish brown (10YR 4/2) and grayish brown (2.5Y 5/2) silty clay; common fine distinct strong brown (7.5YR 5/6) and dark brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; very firm; few very fine roots; few very fine pores; common prominent clay films on faces of peds; medium acid; clear smooth boundary.

Btg3—32 to 50 inches; grayish brown (2.5Y 5/2) silty clay loam; many medium distinct dark brown (7.5YR 4/4) mottles and few medium distinct strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; firm; few very fine roots; few very fine pores; few prominent clay films on faces of peds; slightly acid; clear smooth boundary.

Cg—50 to 63 inches; gray (10YR 6/1) silt loam; many coarse distinct yellowish brown (10YR 5/6) mottles; massive; friable; common fine pores; few fine grains of sediment and quartz; slightly acid.

The solum is 40 to 60 inches thick.

The A horizon has hue of 10YR, value of 3, and chroma of 1 or 2. The E horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. The Bt horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2. It is silty clay and silty clay loam and is strongly acid to slightly acid. The C horizon has hue of 2.5Y or 10YR, value of 4 through 6, and chroma of 1 or 2.

## Chequest Series

The Chequest series consists of deep, poorly drained, moderately slowly permeable soils on bottom lands. Chequest soils formed in alluvium. The slopes range from 0 to 2 percent.

Chequest soils are adjacent to Blackoar and Carlow soils. Blackoar soils are silty throughout and are in similar positions on the landscape. Carlow soils have more clay and are in slightly lower positions.

Typical pedon of Chequest silty clay loam, 2,150 feet east and 1,700 feet north of the southwest corner of sec. 28, T. 59 N., R. 5 W., in Marion County:

Ap—0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; few very fine roots; few very fine vertical pores; slightly acid; abrupt smooth boundary.

A—6 to 13 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate fine angular blocky structure; very firm; few very fine roots; few very fine vertical pores; slightly acid; clear smooth boundary.

Btg1—13 to 21 inches; dark gray (10YR 4/1) silty clay loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium and coarse

prismatic structure parting to moderate fine subangular and angular blocky; firm; few very fine roots; common very fine vertical pores; few prominent clay films on faces of peds; medium acid; gradual smooth boundary.

Btg2—21 to 48 inches; dark gray (10YR 4/1) silty clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium and coarse prismatic structure parting to moderate fine subangular blocky; firm; few very fine roots; common very fine pores; few prominent clay films on faces of peds; medium acid; gradual smooth boundary.

Btg3—48 to 65 inches; dark gray (10YR 4/1) and gray (10YR 5/1) silty clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; firm; few very fine vertical pores; few prominent clay films on faces of peds; medium acid.

The solum is 40 to more than 60 inches thick. The soil is medium acid or slightly acid throughout.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1. There are high chroma mottles throughout the Bt horizon.

## Edina Series

The Edina series consists of deep, poorly drained, very slowly permeable soils on uplands. Edina soils formed in thick loess. The slopes range from 0 to 2 percent.

Edina soils are similar to Putnam soils and commonly are adjacent to Smileyville soils. Putnam soils do not have dark colors in the upper 3 inches of the B horizon. Smileyville soils do not have a mollic epipedon and are in lower positions on the landscape.

Typical pedon of Edina silt loam, 25 feet north and 1,325 feet east of the southwest corner of sec. 4, T. 58 N., R. 6 W., in Marion County:

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine granular structure; very friable; few very fine roots; few very fine pores; neutral; abrupt smooth boundary.

E—9 to 18 inches; dark gray (10YR 4/1) silt loam; few fine distinct yellowish brown (10YR 5/4) mottles; moderate thin platy and moderate fine granular structure; very friable; few very fine roots; common very fine pores and few fine pores; medium acid; abrupt smooth boundary.

Btg1—18 to 21 inches; very dark gray (10YR 3/1) silty clay; common fine prominent yellowish brown (10YR 5/6) mottles; moderate fine angular and subangular blocky structure; very firm; few very fine roots; common very fine pores; many prominent clay films on faces of peds; medium acid; clear smooth boundary.

Btg2—21 to 32 inches; very dark gray (10YR 3/1) and dark grayish brown (10YR 4/2) silty clay; common fine prominent yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; very firm; few very fine roots; few very fine pores; many prominent clay films on faces of peds; slightly acid; clear smooth boundary.

Btg3—32 to 42 inches; dark grayish brown (2.5Y 4/2) silty clay; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few very fine roots; few very fine pores; common prominent clay films on faces of peds; slightly acid; clear smooth boundary.

Btg4—42 to 59 inches; mottled dark grayish brown (2.5Y 4/2), light brownish gray (2.5Y 6/2), and yellowish brown (10YR 5/6) silty clay; weak medium subangular blocky structure; firm; few very fine pores; few black oxide stains; common prominent clay films on faces of peds; neutral; clear smooth boundary.

Cg—59 to 63 inches; gray (10YR 5/1) silty clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; massive; firm; few very fine pores; neutral.

The solum is 45 to more than 60 inches thick.

The Ap or A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. The upper part of the B horizon has hue of 10YR, value of 2 or 3, and chroma of 1; the lower part has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The B horizon is slightly acid or neutral. The C horizon is similar in color to the B horizon. It is silty clay loam or silt loam. There are high chroma mottles throughout the B and C horizons.

## Fatima Series

The Fatima series consists of deep, moderately well drained, moderately permeable soils on bottom lands. Fatima soils formed in silty alluvium. The slopes range from 0 to 2 percent.

Fatima soils commonly are adjacent to Landes soils. Landes soils are on natural levees near stream channels. They are coarser in texture than the Fatima soils.

Typical pedon of Fatima silt loam, 2,145 feet south and 1,320 feet east of the southwest corner of sec. 32, T. 55 N., R. 4 W., in Ralls County:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; few very fine roots; common very fine pores; slightly acid; clear smooth boundary.

A—8 to 18 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium platy and moderate fine granular structure; very friable; few very fine pores, common fine pores, and few medium pores; slightly acid; gradual smooth boundary.

Bw1—18 to 30 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; very friable; few fine pores; slightly acid; gradual smooth boundary.

Bw2—30 to 50 inches; dark grayish brown (10YR 4/2) silt loam; few fine distinct yellowish brown (10YR 5/4) mottles; weak fine subangular blocky and moderate fine granular structure; friable; common fine pores; slightly acid; gradual smooth boundary.

C—50 to 68 inches; dark grayish brown (10YR 4/2) silt loam; common medium distinct dark gray (10YR 4/1) mottles and few fine distinct dark brown (7.5YR 4/4) mottles; massive; friable; few fine pores; slightly acid.

The solum is 40 to about 60 inches thick. Reaction in the Bw and C horizons is slightly acid or neutral.

The A horizon has hue of 10YR, value of 3, and chroma of 1 or 2. It is dominantly silt loam, but the range includes silty clay loam and loam. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 2. The C horizon is similar in color to the B horizon. There are mottles of high and low chroma in the B and C horizons.

## Gifford Series

The Gifford series consists of deep, poorly drained, very slowly permeable soils on stream terraces. Gifford soils formed in thin loess and alluvial sediment. The slopes range from 2 to 9 percent.

Gifford soils are similar to Mexico soils and commonly are adjacent to Chariton soils. Chariton soils are nearly level and have an E horizon. They are in slightly higher positions on the landscape. Mexico soils do not have alluvial sediment in the lower horizons.

Typical pedon of Gifford silt loam, 2 to 5 percent slopes, 60 feet east and 3,300 feet south of the northwest corner of sec. 19, T. 55 N., R. 6 W., in Ralls County:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; few very fine roots; few very fine pores; neutral; clear smooth boundary.

Btg1—8 to 12 inches; dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) silty clay loam; common fine distinct strong brown (7.5YR 5/6) and dark brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; firm; few very fine roots; few fine pores; many prominent clay films on faces of peds; strongly acid; clear smooth boundary.

Btg2—12 to 36 inches; dark grayish brown (2.5Y 4/2) silty clay; many fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; very firm; few very fine roots; common very fine pores; many prominent clay films on faces of peds; medium acid; clear smooth boundary.

Btg3—36 to 42 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak and moderate fine subangular blocky structure; very firm; few very fine roots; common very fine pores; common prominent clay films on faces of peds; slightly acid; clear smooth boundary.

Cg—42 to 65 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and prominent strong brown (7.5YR 5/6) mottles; massive; firm; few very fine pores; few prominent clay films in pores and few prominent clay films on faces of peds; few to common sand grains; slightly acid.

The solum ranges from 30 to more than 60 inches in thickness.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The Bt horizon is dominantly silty clay, but the range includes silty clay loam. The Btg horizon is strongly acid to slightly acid. The C horizon has hue of 5Y, 2.5Y, or 10YR, value of 4 to 6, and chroma of 1 or 2.

## Gorin Series

The Gorin series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. Gorin soils formed in loess and glacial sediment. The slopes range from 5 to 9 percent.

Gorin soils are similar to Weller soils and commonly are adjacent to Armstrong and Calwoods soils. Armstrong soils have glacial sand and pebbles throughout. They are in similar positions on the landscape or are on the lower part of side slopes. Calwoods and Weller soils do not have glacial sand and pebbles in the lower horizons and are upslope from Gorin soils.

Typical pedon of Gorin silt loam, 5 to 9 percent slopes, 100 feet east and 2,500 feet south of the northwest corner of sec. 32, T. 56 N., R. 6 W., in Ralls County:

A—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; many very fine roots and few fine roots; common fine pores; medium acid; abrupt smooth boundary.

E—3 to 8 inches; brown (10YR 5/3) silt loam; weak medium platy and moderate fine granular structure;



friable; common fine roots; common fine pores; strongly acid; abrupt smooth boundary.

BE—8 to 13 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak fine subangular blocky structure; firm; brown silt coats on surfaces of peds; few very fine roots; common very fine pores and few fine pores; strongly acid; clear smooth boundary.

Bt1—13 to 23 inches; dark brown (7.5YR 4/4) silty clay; common fine distinct dark grayish brown (10YR 4/2) mottles; moderate fine subangular and angular blocky structure; very friable; few fine roots and very few coarse roots; few very fine pores and few fine pores; many prominent clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—23 to 32 inches; grayish brown (10YR 5/2) silty clay; common fine distinct dark yellowish brown (10YR 4/4) and prominent reddish brown (5YR 4/4) mottles; moderate fine subangular blocky structure; firm; few very fine roots; few very fine pores; common prominent clay films on faces of peds; strongly acid; clear smooth boundary.

2Bt3—32 to 54 inches; grayish brown (10YR 5/2) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few very fine roots; few very fine pores; few prominent clay films on faces of peds; moderate amount of coarse sand; strongly acid; clear smooth boundary.

2Bt4—54 to 67 inches; mottled yellowish brown (10YR 5/4), dark brown (7.5YR 4/4), and pale brown (10YR 6/3) clay loam; weak medium subangular blocky structure; firm; few very fine pores; few prominent clay films on faces of peds; slightly acid.

The solum is 48 to more than 60 inches thick.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 1 through 3. The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 4. It is silty clay and silty clay loam. The 2B horizon has hue of 7.5YR or 10YR, value of 5, and chroma of 2 to 6. There are mottles that have hue of 2.5YR through 10YR and high value and chroma throughout the B horizon. The B horizon is medium acid or strongly acid.

## Gosport Series

The Gosport series consists of moderately deep, moderately well drained, very slowly permeable soils on uplands. Gosport soils formed in residuum of acid shale. The slopes range from 9 to 20 percent.

The Gosport soils in the survey area are less acid than is defined for the Gosport series. This difference, however, does not affect the usefulness or behavior of these soils.

Gosport soils commonly are adjacent to Goss and Armstrong soils, which are in higher positions on the landscape. Armstrong soils have glacial sand and pebbles throughout. Goss soils are cherty throughout.

Typical pedon of Gosport silty clay loam, 14 to 20 percent slopes, 3,000 feet west and 4,700 feet south of the northeast corner of sec. 5, T. 55 N., R. 3 W., in Ralls County:

A—0 to 2 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many very fine and fine roots; common very fine pores; very strongly acid; abrupt smooth boundary.

E—2 to 4 inches; brown (10YR 5/3) silty clay loam; moderate fine subangular blocky structure; firm; common fine roots and few medium roots; common very fine pores; very strongly acid; abrupt smooth boundary.

BE—4 to 9 inches; light olive brown (2.5Y 5/4) silty clay; moderate fine subangular and angular blocky structure; firm; common fine roots and few medium and coarse roots; common very fine pores; medium acid; clear smooth boundary.

Bw—9 to 18 inches; light olive brown (2.5Y 5/4) clay; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very firm; common fine roots and few coarse roots; many very fine pores; slightly acid; clear smooth boundary.

BC—18 to 29 inches; dark grayish brown (2.5Y 4/2) silty clay, dark grayish brown (10YR 4/2) kneaded; common medium distinct yellowish brown (10YR 5/6) and gray (5Y 5/1) mottles; weak thin platy structure; very firm; common fine roots and few medium roots; common very fine pores; mildly alkaline; clear smooth boundary.

Cr—29 to 62 inches; mottled dark grayish brown (2.5Y 4/2), olive brown (2.5Y 4/4), and gray (5Y 5/1) partly weathered clay shale.

The solum is 20 to more than 30 inches thick. Depth to bedrock ranges from 20 to 40 inches.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. The B horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 through 4. The B horizon is dominantly silty clay, but the range includes clay. The Bw horizon is mainly medium acid or slightly acid, but it ranges to mildly alkaline. The C horizon has hue of 7.5YR through 2.5Y, value of 4 through 6, and chroma of 1 through 6.

## Goss Series

The Goss series consists of deep, well drained, moderately permeable, cherty soils on uplands. Goss soils formed in residuum of cherty limestone. The slopes range from 15 to 30 percent.

Goss soils commonly are adjacent to Gorin, Gosport, Menfro, and Winfield soils, which are upslope from Goss soils. Gorin, Menfro, and Winfield soils do not have



chert. Gosport soils are moderately deep and do not have chert.

Typical pedon of Goss cherty silt loam, 15 to 30 percent slopes, 1,950 feet east and 4,000 feet north of the southwest corner of sec. 6, T. 55 N., R. 6 W., in Ralls County:

- A—0 to 5 inches; very dark grayish brown (10YR 3/2) cherty silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; many very fine roots; few very fine pores; 15 percent chert fragments; neutral; clear smooth boundary.
- Bt1—5 to 10 inches; reddish brown (5YR 4/4) cherty silty clay; moderate fine angular and subangular blocky structure; firm; common very fine roots; few very fine pores; few prominent clay films on faces of peds; 50 percent chert fragments; medium acid; clear smooth boundary.
- Bt2—10 to 21 inches; reddish brown (5YR 4/4) cherty silty clay; moderate fine subangular blocky structure; very firm; few very fine and fine roots; few very fine pores; common prominent clay films on faces of peds; 75 percent chert fragments; medium acid; clear smooth boundary.
- Bt3—21 to 40 inches; yellowish red (5YR 5/6) cherty silty clay; weak and moderate fine subangular blocky structure; very firm; few very fine and medium roots; few very fine pores; common prominent clay films on faces of peds; 60 percent chert fragments; medium acid; clear smooth boundary.
- Bt4—40 to 62 inches; yellowish brown (10YR 5/6) cherty silty clay; few fine distinct strong brown (7.5YR 5/6) mottles and few fine distinct brown (10YR 5/3) mottles; weak and moderate fine subangular blocky structure; very firm; few very fine and medium roots; few very fine pores; few prominent clay films on faces of peds; 60 percent chert fragments; strongly acid.

The solum is 55 to more than 72 inches thick.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 through 4. It is dominantly cherty silt loam, but the range includes silt loam. The Bt horizon has hue of 2.5YR through 10YR, value of 3 through 5, and chroma of 4 through 8. It is medium acid to strongly acid.

## Landes Series

The Landes series consists of deep, moderately well drained, moderately rapidly permeable soils on flood plains. Landes soils formed in loamy alluvium. The slopes range from 0 to 2 percent.

Landes soils commonly are adjacent to Fatima soils, which are in slightly lower positions on the landscape. Fatima soils are silty throughout.

Typical pedon of Landes fine sandy loam, 2,600 feet north and 1,725 feet west of the southeast corner of sec. 36, T. 56 N., R. 7 W., in Ralls County:

- A1—0 to 7 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; very friable; few very fine roots; few fine pores; neutral; clear smooth boundary.
- A2—7 to 20 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak thin platy and moderate fine granular structure; friable; very few fine roots; common very fine pores; neutral; clear smooth boundary.
- Bw—20 to 38 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; few fine faint dark brown (10YR 4/3) mottles; weak fine subangular blocky and moderate fine granular structure; friable; few very fine roots; common very fine pores; neutral; clear smooth boundary.
- C—38 to 60 inches; brown (10YR 5/3) fine sand; massive; friable; few very fine pores; neutral.

Reaction is neutral or slightly acid throughout.

The A horizon has hue of 10YR, value of 3, and chroma of 2 or 3. It ranges from loam to fine sand. The B horizon has hue of 10YR, value of 3 or 4, and chroma of 2 through 4. The C horizon has hue of 10YR, value of 4 through 6, and chroma of 3 or 4.

## Leonard Series

The Leonard series consists of deep, poorly drained, slowly permeable soils on uplands. Leonard soils formed in thin loess and pedisement. The slopes range from 5 to 9 percent.

Leonard soils are similar to Gifford and Mexico soils and commonly are adjacent to Armstrong and Mexico soils. Armstrong soils have glacial sand and pebbles throughout and are downslope from Leonard soils. Gifford soils have a thinner Bt horizon and less clay. Mexico soils have a Bt horizon that is redder and contains less sand.

Typical pedon of Leonard silt loam, 5 to 9 percent slopes, 550 feet south and 1,275 feet west of the northeast corner of sec. 35, T. 54 N., R. 7 W., in Ralls County:

- Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; few fine roots; slightly acid; abrupt smooth boundary.
- Btg1—8 to 14 inches; dark grayish brown (10YR 4/2) silty clay loam; common fine distinct yellowish red (5YR 4/6) mottles and few fine distinct red (2.5YR 4/6) mottles; weak fine subangular blocky structure; firm; few prominent clay films on faces of peds; very strongly acid; clear smooth boundary.
- Btg2—14 to 24 inches; dark grayish brown (10YR 4/2) silty clay; many fine distinct yellowish red (5YR 4/6) mottles; moderate fine subangular blocky structure;

very firm; common prominent clay films on faces of peds; very strongly acid; clear smooth boundary.

2Btg3—24 to 33 inches; gray (10YR 5/1) silty clay; common fine faint strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; very firm; common prominent clay films on faces of peds; black (10YR 2/1) oxide stains; few clear sand grains; medium acid; clear smooth boundary.

2Btg4—33 to 42 inches; grayish brown (10YR 5/2) silty clay; common medium distinct strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; very firm; few prominent clay films on faces of peds; few fine white chert fragments; common clear sand grains; medium acid; clear smooth boundary.

2Btg5—42 to 65 inches; light brownish gray (2.5Y 6/2) silty clay; few medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few distinct clay films on faces of peds; many fine white chert fragments; few clear sand grains; neutral.

The solum is 40 to 80 inches thick.

The A horizon has hue of 10YR, value of 3, and chroma of 1 or 2. It is dominantly silt loam, but the range includes silty clay loam. The B horizon has hue of 10YR or 2.5Y, value of 4 through 6, and chroma of 1 or 2. The B horizon is neutral to very strongly acid.

## Lindley Series

The Lindley series consists of deep, moderately well drained, moderately slowly permeable soils on uplands. Lindley soils formed in glacial till. The slopes range from 14 to 35 percent.

Lindley soils commonly are adjacent to Armstrong and Goss soils. Armstrong soils have a higher clay content than Lindley soils and are redder. They are upslope from Lindley soils. Goss soils are cherty throughout and are in lower positions.

Typical pedon of Lindley loam, 20 to 35 percent slopes, 4,875 feet south and 2,900 feet east of the northwest corner of sec. 13, T. 55 N., R. 7 W., in Ralls County:

A—0 to 2 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; very friable; many fine roots; strongly acid; abrupt smooth boundary.

E—2 to 6 inches; dark grayish brown (10YR 4/2) loam; weak very fine granular structure; friable; many fine roots; very strongly acid; abrupt smooth boundary.

Bt1—6 to 10 inches; yellowish brown (10YR 5/4) clay loam; weak fine subangular blocky structure; firm; common fine roots; few prominent clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt2—10 to 17 inches; yellowish brown (10YR 5/6) clay loam; moderate fine subangular blocky structure; firm; common fine roots; common prominent clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt3—17 to 31 inches; yellowish brown (10YR 5/6) clay loam; few fine distinct gray (10YR 6/1) mottles; moderate medium subangular and angular blocky structure; very firm; common fine roots; common prominent clay films on faces of peds; very strongly acid; gradual smooth boundary.

C1—31 to 48 inches; yellowish brown (10YR 5/4) clay loam; common coarse distinct gray (10YR 6/1) mottles; massive; very firm; many soft accumulations of calcium; mildly alkaline; clear smooth boundary.

C2—48 to 67 inches; yellowish brown (10YR 5/6) clay loam; massive; very firm; few soft accumulations of calcium; mildly alkaline.

The solum is 30 to 50 inches thick.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. It is dominantly loam, but the range includes silt loam. The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 through 6. The Bt horizon is strongly acid or very strongly acid.

## Marion Series

The Marion series consists of deep, somewhat poorly drained, very slowly permeable soils on terraces. Marion soils formed in loess. The slopes range from 2 to 5 percent.

Marion soils are similar to Putnam soils and commonly are adjacent to Calwoods and Gorin soils. Calwoods and Gorin soils do not have an abrupt textural change between the A and B horizons and are on lower ridgetops and side slopes. Putnam soils have a dark surface layer that is more than 6 inches thick.

Typical pedon of Marion silt loam, 2 to 5 percent slopes, 750 feet north and 675 feet west of the southeast corner of sec. 13, T. 58 N., R. 6 W., in Marion County:

A—0 to 3 inches; dark brown (10YR 4/3) silt loam; light brownish gray (10YR 6/2) dry; moderate fine granular structure; very friable; common very fine roots; common very fine pores and few fine pores; slightly acid; abrupt smooth boundary.

E1—3 to 9 inches; grayish brown (10YR 5/2) silt loam; few fine distinct yellowish brown (10YR 5/4, 5/6) mottles; moderate thin platy and moderate fine granular structure; very friable; few very fine roots; common very fine pores and few fine pores; strongly acid; clear smooth boundary.

E2—9 to 13 inches; light brownish gray (10YR 6/2) silt loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak thin platy and moderate fine granular

structure; friable; few very fine roots; few very fine pores and few fine pores; very strongly acid; abrupt smooth boundary.

- Bt1—13 to 20 inches; brown (10YR 5/3) silty clay; few fine distinct light brownish gray (10YR 6/2) and prominent strong brown (7.5YR 5/6) mottles; moderate fine angular and subangular blocky structure; very firm; common faint light brownish gray (2.5Y 6/2) silt coats on faces of peds; few very fine roots; common very fine pores and few fine pores; many prominent clay films on faces of peds; strongly acid; gradual smooth boundary.
- Bt2—20 to 32 inches; brown (10YR 5/3) silty clay; few fine distinct grayish brown (2.5Y 5/2) mottles and common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very firm; common faint light brownish gray (2.5Y 6/2) silt coats on faces of peds; few very fine pores; common prominent clay films on faces of peds; strongly acid; clear smooth boundary.
- Bt3—32 to 51 inches; grayish brown (10YR 5/2) silty clay loam; few fine faint brown (10YR 5/3) and distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few very fine pores; few prominent clay films on faces of peds; very strongly acid; clear smooth boundary.
- C—51 to 63 inches; grayish brown (2.5Y 5/2) silty clay loam; massive; friable; few very fine pores; medium acid.

The solum is 40 to 60 inches thick. The E and Bt horizons are strongly acid or very strongly acid.

The A horizon has hue of 10YR, value of 3 through 6, and chroma of 2 or 3. The E horizon has hue of 10YR, value of 5 through 7, and chroma of 2 or 3. The B horizon has hue of 2.5Y or 10YR, value of 5 or 6, and chroma of 3. The B horizon is silty clay, clay, or silty clay loam. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2. It is silt loam or silty clay loam.

## Menfro Series

The Menfro series consists of deep, well drained, moderately permeable soils on uplands. Menfro soils formed in thick loess. The slopes range from 2 to 35 percent.

Menfro soils are similar to Winfield soils and commonly are adjacent to Goss and Weller soils. Goss soils are cherty throughout and are on the lower part of side slopes. Weller soils have more clay than Menfro soils. They have mottles that have chroma of 2 in the upper part of the B horizon and are in positions on the landscape similar to those of Menfro soils. Winfield soils have mottles that have chroma of 2 in the lower part of the B horizon.

Typical pedon of Menfro silt loam, 5 to 9 percent slopes, eroded, 2,275 feet west and 2,150 feet south of

the northeast corner of sec. 6, T. 58 N., R. 5 W., in Marion County:

- Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; very friable; few very fine roots; few very fine pores; neutral; clear smooth boundary.
- BA—6 to 14 inches; dark brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; friable; few very fine roots; common very fine pores; medium acid; clear smooth boundary.
- Bt1—14 to 37 inches; dark brown (10YR 4/3) silty clay loam; moderate fine subangular blocky structure; firm; few very fine roots; common very fine pores and few medium pores; common prominent clay films on faces of peds; medium acid; gradual smooth boundary.
- Bt2—37 to 62 inches; dark brown (10YR 4/3) silty clay loam; weak medium subangular blocky structure; firm; few very fine roots; common very fine pores and few fine pores; few prominent clay films in pores; medium acid.

The solum is 40 to 60 inches thick. It is medium acid to neutral.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. The B horizon has hue of 7.5YR or 10YR, value of 4, and chroma of 3 or 4.

## Mexico Series

The Mexico series consists of deep, somewhat poorly drained, very slowly permeable soils on uplands. Mexico soils formed in loess or in silty material that was less than 10 percent sand. The slopes range from 2 to 5 percent.

Mexico soils are similar to Calwoods soils and commonly are adjacent to Leonard and Putnam soils. Calwoods soils have a lighter colored surface layer. Leonard soils have more sand, and their subsoil is not so red as that of Mexico soils. They are downslope. Putnam soils have a prominent E horizon and are on wide, slightly higher divides.

Typical pedon of Mexico silty clay loam, 2 to 5 percent slopes, eroded, 1,150 feet south and 100 feet east of the northwest corner of sec. 8, T. 54 N., R. 6 W., in Ralls County:

- Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; very friable; few very fine roots; few very fine pores; slightly acid; abrupt smooth boundary.
- Btg1—8 to 18 inches; dark grayish brown (10YR 4/2) silty clay; many fine prominent red (2.5YR 4/6) mottles; moderate fine angular blocky and

subangular blocky structure; firm; few very fine roots; few very fine pores; many thick continuous clay films on faces of peds; strongly acid; clear smooth boundary.

Btg2—18 to 24 inches; grayish brown (10YR 5/2) silty clay; common medium prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; very firm; few very fine roots; few very fine pores; many prominent clay films on faces of peds; strongly acid; clear smooth boundary.

Btg3—24 to 28 inches; gray (10YR 5/1) silty clay; few fine distinct yellowish brown (10YR 5/6) mottles; common medium subangular blocky structure; very firm; few very fine roots; few very fine pores; common prominent clay films on faces of peds; strongly acid; clear smooth boundary.

Btg4—28 to 37 inches; grayish brown (10YR 5/2) silty clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few very fine roots; few very fine pores; common prominent clay films on faces of peds; medium acid; clear smooth boundary.

Cg—37 to 66 inches; gray (10YR 6/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; few very fine pores; few prominent clay films in pores; neutral.

The solum is 30 to more than 50 inches thick.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 2 or 3. It is dominantly silty clay loam, but the range includes silt loam. The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is medium acid or strongly acid. The C horizon has hue of 10YR, value of 4 through 6, and chroma of 1 through 6.

## Moniteau Series

The Moniteau series consists of deep, poorly drained, slowly permeable soils on bottom lands. Moniteau soils formed in silty alluvium. The slopes range from 0 to 2 percent.

Moniteau soils are adjacent to Belknap and Landes soils. Belknap soils have less clay and are in similar positions on the landscape. Landes soils have more sand and are slightly higher on natural levees.

Typical pedon of Moniteau silt loam, approximately 80 feet south and 100 feet east of the northwest corner of sec. 17, T. 55 N., R. 6 W., in Ralls County:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine granular structure; friable; few very fine roots; very few very fine pores; neutral; abrupt smooth boundary.

E—9 to 17 inches; gray (10YR 6/1) silt loam; few fine distinct dark brown (10YR 4/3) mottles; moderate medium platy and moderate fine granular structure;

friable; few fine roots; common very fine pores; medium acid; clear smooth boundary.

Btg1—17 to 45 inches; grayish brown (10YR 5/2) silty clay loam; few medium distinct dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; firm; very few very fine roots; very few very fine pores; many prominent clay films on faces of peds; very strongly acid; gradual smooth boundary.

Btg2—45 to 64 inches; grayish brown (10YR 5/2) silt loam; many medium prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; few very fine pores; few prominent clay films on faces of peds; medium acid.

The solum is 36 to more than 70 inches thick.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. The Btg horizon has hue of 10YR, value of 4 through 6, and chroma of 1 or 2. There are mottles that have chroma of more than 2 throughout the soil. The E and Btg horizons are medium acid to very strongly acid.

## Putnam Series

The Putnam series consists of deep, poorly drained, very slowly permeable soils on uplands. Putnam soils formed in deep loess. The slopes range from 0 to 2 percent.

Putnam soils are similar to Edina and Smileyville soils and commonly are adjacent to Mexico soils. Edina soils have a mollic epipedon. Mexico soils do not have a thick E horizon and are downslope from Putnam soils. Smileyville soils have less clay in the argillic horizon.

Typical pedon of Putnam silt loam, 100 feet east and 1,200 feet south of the northwest corner of sec. 6, T. 56 N., R. 6 W., in Ralls County:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; very friable; few very fine roots; common very fine pores; neutral; abrupt smooth boundary.

E—9 to 16 inches; gray (10YR 5/1) silt loam; few fine distinct dark brown (7.5YR 4/4) mottles; moderate medium platy and moderate fine granular structure; very friable; few very fine roots; many very fine pores and common fine pores; strongly acid; abrupt smooth boundary.

Btg1—16 to 20 inches; dark gray (10YR 4/1) silty clay; many fine distinct reddish brown (5YR 4/4) mottles; moderate fine subangular blocky structure; very firm; few very fine roots; common very fine pores; many prominent clay films on faces of peds; very strongly acid; clear smooth boundary.

Btg2—20 to 27 inches; dark grayish brown (10YR 4/2) silty clay; common fine prominent strong brown

(7.5YR 5/6) mottles; moderate medium subangular blocky structure; very firm; few very fine roots; common very fine pores; many prominent clay films on faces of peds; very strongly acid; clear smooth boundary.

Btg3—27 to 35 inches; grayish brown (2.5Y 5/2) silty clay; common medium prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; very firm; very dark grayish brown (10YR 3/2) clay flows; very few very fine roots; common very fine pores; many prominent clay films on faces of peds; strongly acid; clear smooth boundary.

Btg4—35 to 48 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium prominent yellowish red (5YR 4/6) mottles; weak medium subangular blocky structure; firm; very dark grayish brown (10YR 3/2) clay flows; very few very fine roots; common very fine pores; many prominent clay films on faces of peds; strongly acid; clear smooth boundary.

Cg—48 to 62 inches; gray (10YR 6/1) silty clay loam; many coarse prominent dark brown (7.5YR 4/4) mottles; massive; friable; few fine pores; few to common quartz grains, increasing with depth; medium acid.

The solum is 36 to about 60 inches thick.

The Ap horizon has hue of 10YR, value of 3, and chroma of 1 or 2. The E horizon has hue of 10YR, value of 5 or 6, and chroma of 1 or 2. The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is strongly acid or very strongly acid. The C horizon has hue of 2.5Y or 10YR, value of 5 or 6, and chroma of 1 or 2. There are mottles that have hue of 2.5YR through 7.5YR, value of 4 or 5, and chroma of 4 through 8 throughout the B and C horizons.

## Sampsel Series

The Sampsel series consists of deep, poorly drained, slowly permeable soils on uplands. Sampsel soils formed in residuum of alkaline shale. The slopes range from 5 to 14 percent.

Sampsel soils are adjacent to Armstrong, Gosport, Goss, and Leonard soils. Armstrong soils have glacial sand and gravel throughout and are upslope from Sampsel soils. Gosport soils are in steeper convex areas. Goss soils have chert throughout and are downslope. Leonard soils are upslope. None of these soils has a mollic epipedon.

Typical pedon of Sampsel silty clay loam, 9 to 14 percent slopes, 1,750 feet south and 125 feet west of the northeast corner of sec. 24, T. 55 N., R. 7 W., in Ralls County:

A1—0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate medium

granular structure; friable; common medium roots; neutral; clear smooth boundary.

A2—6 to 13 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; firm; common medium roots; slightly acid; clear smooth boundary.

Bt1—13 to 19 inches; very dark grayish brown (2.5Y 3/2) silty clay loam, grayish brown (2.5Y 5/2) dry; moderate fine subangular blocky structure; firm; few fine roots; few prominent clay films on faces of peds; slightly acid; clear smooth boundary.

Btg2—19 to 24 inches; olive gray (5Y 5/2) silty clay; common medium prominent dark brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; firm; few fine roots; few prominent clay films on faces of peds; slightly acid; clear smooth boundary.

Btg3—24 to 35 inches; olive gray (5Y 4/2) silty clay; few fine prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; few prominent clay films on faces of peds; slightly acid; clear smooth boundary.

Btg4—35 to 65 inches; olive (5Y 5/3) silty clay; few fine prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very firm; few prominent clay films on faces of peds; neutral.

The solum is 36 to 70 inches thick.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. It is silt loam, but the range includes silty clay loam. The Bt horizon has hue of 2.5Y or 5Y and value of 3 through 6; the upper part has chroma of 1 or 2, and the lower part has chroma of 2 through 4. There are mottles that have higher and lower chroma throughout. The B horizon is slightly acid or neutral.

## Smileyville Series

The Smileyville series consists of deep, poorly drained, slowly permeable soils on uplands. Smileyville soils formed in loess. The slopes range from 2 to 7 percent.

Smileyville soils are similar to Putnam soils and commonly are adjacent to Armstrong, Edina, and Menfro soils. Armstrong soils have glacial sand and pebbles throughout and are downslope from Smileyville soils. Edina soils have a mollic epipedon and are on wide, slightly higher ridgetops. Menfro soils have a light colored surface layer, and they have less clay. They are on narrow ridgetops and in steeper areas. Putnam soils have more clay in the argillic horizon.

Typical pedon of Smileyville silt loam, 2 to 6 percent slopes, 120 feet north and 2,350 feet west of the center of sec. 34, T. 59 N., R. 6 W., in Marion County:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; very friable; few very fine



roots; few very fine pores; slightly acid; abrupt smooth boundary.

E—9 to 14 inches; grayish brown (10YR 5/2) silt loam; few fine distinct dark brown (10YR 4/3) mottles; weak medium platy and moderate fine granular structure; very friable; few very fine roots; common very fine pores; slightly acid; abrupt smooth boundary.

Btg1—14 to 27 inches; dark grayish brown (10YR 4/2) silty clay; many fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular and angular blocky structure; firm; common very fine roots; common very fine pores; common prominent clay films on faces of peds; strongly acid; clear smooth boundary.

Btg2—27 to 39 inches; grayish brown (10YR 5/2) silty clay; many medium prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; very firm; few very fine roots; common very fine pores; common prominent clay films on faces of peds and few prominent clay films in pores; strongly acid; clear smooth boundary.

Btg3—39 to 49 inches; grayish brown (2.5Y 5/2) silty clay loam; many medium prominent yellowish brown (10YR 5/6) mottles and few fine prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm; common very fine pores; common prominent clay films on faces of peds and few prominent clay films in pores; medium acid; clear smooth boundary.

BCg—49 to 63 inches; mottled grayish brown (2.5Y 5/2) and gray (10YR 5/1) silty clay loam; many coarse prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; common very fine pores; medium acid.

The solum is 40 to more than 60 inches thick.

The Ap horizon has hue of 10YR, value of 3, and chroma of 1 or 2. The E horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. The Bt horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 1 or 2. It is silty clay, clay, or silty clay loam. The BC horizon has colors similar to those of the Bt horizon. There are mottles of high chroma throughout the soil. The B horizon is medium acid or strongly acid.

## Vigar Series

The Vigar series consists of deep, moderately well drained, moderately slowly permeable soils on foot slopes of uplands. Vigar soils formed in local alluvium washed from soils that formed in loess and glacial till. The slopes range from 2 to 5 percent.

Vigar soils are adjacent to Belknap and Blackoar soils. Belknap soils have a lighter colored surface layer. They are silt loam throughout and are on bottom lands. Blackoar soils have a gray B horizon, and they have less sand and clay. They are on bottom lands.

Typical pedon of Vigar loam, 2 to 5 percent slopes, 700 feet south and 1,450 feet west of the northeast corner of sec. 17, T. 58 N., R. 8 W., in Marion County:

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; common fine roots; common fine pores; slightly acid; clear smooth boundary.

A—6 to 12 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; few fine roots; few fine pores; slightly acid; clear smooth boundary.

BA—12 to 18 inches; very dark grayish brown (10YR 3/2) clay loam, grayish brown (10YR 5/2) dry; few fine faint dark brown (10YR 4/3) mottles; weak fine subangular blocky structure; firm; few fine roots; few fine pores; few faint clay films; slightly acid; gradual smooth boundary.

Bt1—18 to 28 inches; very dark grayish brown (10YR 3/2) clay loam, grayish brown (10YR 5/2) dry; common fine distinct yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; firm; few very fine roots; common very fine pores; few faint clay films; slightly acid; clear smooth boundary.

Bt2—28 to 43 inches; grayish brown (10YR 5/2) clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; few fine pores; common faint clay films; slightly acid; gradual smooth boundary.

BC—43 to 62 inches; grayish brown (10YR 5/2) clay loam; common medium prominent dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; firm; few fine pores; few faint clay films; neutral.

The solum is 40 to more than 55 inches thick.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The Bt horizon has hue of 10YR, value of 3 through 5, and chroma of 2 or 3, and it has mottles that have higher chroma. The Bt and BC horizons are slightly acid or neutral.

## Weller Series

The Weller series consists of deep, moderately well drained, slowly permeable soils on uplands. Weller soils formed in loess. The slopes range from 2 to 5 percent.

Weller soils are similar to Gorin soils and commonly are adjacent to Winfield soils. Gorin soils have more clay and have glacial sand and pebbles in the lower horizons. Winfield soils have less clay and do not have mottles that have chroma of 2 in the upper part of the B horizon.

Typical pedon of Weller silt loam, 2 to 5 percent slopes, 2,000 feet west and 800 feet south of the northeast corner of sec. 9, T. 56 N., R. 4 W., in Ralls County:



- A—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; very friable; common very fine roots and few fine roots; few very fine pores; neutral; abrupt smooth boundary.
- E—6 to 14 inches; brown (10YR 5/3) silt loam; common fine distinct light brownish gray (10YR 6/2) mottles; moderate medium platy structure; very friable; few very fine roots; common very fine pores; very strongly acid; abrupt smooth boundary.
- BE—14 to 18 inches; yellowish brown (10YR 5/4) silty clay loam; few light gray (10YR 7/2) silt coats; moderate fine subangular blocky structure; firm; few very fine roots; common very fine pores; slightly acid; clear smooth boundary.
- Bt1—18 to 24 inches; dark yellowish brown (10YR 4/4) silty clay; few fine distinct grayish brown (2.5Y 5/2) and dark brown (7.5YR 4/4) mottles; light gray (10YR 7/2) silt coats; moderate fine subangular and angular blocky structure; firm; few fine roots; few very fine pores; common prominent clay films on faces of peds; strongly acid; clear smooth boundary.
- Bt2—24 to 38 inches; dark yellowish brown (10YR 4/4) silty clay; common medium distinct grayish brown (2.5Y 5/2) mottles and few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few very fine roots; few very fine pores; common prominent clay films on faces of peds; very strongly acid; clear smooth boundary.
- Bt3—38 to 52 inches; mottled dark yellowish brown (10YR 4/4), grayish brown (2.5Y 5/2), and strong brown (7.5YR 5/6) silty clay loam; weak medium subangular blocky structure; friable; few black (10YR 2/1) oxide stains; few very fine roots; few fine pores; few prominent clay films on faces of peds; very strongly acid; gradual smooth boundary.
- C—52 to 63 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) silt loam; massive; very friable; common black (10YR 2/1) oxide stains; few very fine roots; few very fine pores; slightly acid.

The solum is 36 to more than 60 inches thick.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. The E horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 6. It is strongly acid or very strongly acid. The C horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 to 6. There are mottles that have hue of 2.5Y, 5Y, or 7.5YR and high or low chroma in the B and C horizons.

## Winfield Series

The Winfield series consists of deep, moderately well drained, moderately permeable soils on uplands. Winfield soils formed in thick loess. The slopes range from 5 to 14 percent.

Winfield soils are similar to Menfro soils and commonly are adjacent to Goss and Weller soils. Goss soils are cherty throughout and are in positions on the landscape lower than those of Winfield soils. Menfro soils do not have mottles that have chroma of 2 in the lower part of the subsoil. Weller soils have more clay and are upslope from Winfield soils.

Typical pedon of Winfield silt loam, 9 to 14 percent slopes, eroded, 500 feet east and 2,450 feet south of the northwest corner of sec. 4, T. 59 N., R. 6 W., in Marion County:

- A—0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; friable; many very fine roots and few medium roots; few very fine pores; medium acid; clear smooth boundary.
- E—4 to 10 inches; yellowish brown (10YR 5/4) and dark brown (10YR 4/3) silt loam; moderate medium platy and moderate fine granular structure; friable; common very fine roots; common fine pores; strongly acid; clear smooth boundary.
- BE—10 to 16 inches; yellowish brown (10YR 5/4) silt loam; weak fine subangular blocky structure; friable; common fine roots and few medium roots; many very fine pores; strongly acid; clear smooth boundary.
- Bt1—16 to 23 inches; yellowish brown (10YR 5/4) silty clay loam; common light gray (10YR 7/2) silt coats; moderate fine subangular blocky structure; firm; common fine roots and few very fine roots; common very fine pores; common prominent clay films on faces of peds; strongly acid; clear smooth boundary.
- Bt2—23 to 29 inches; yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) silty clay loam; common fine distinct light brownish gray (10YR 6/2) mottles; common light gray (10YR 7/1) silt coats; moderate fine subangular blocky structure; very firm; few medium roots and few very fine roots; few very fine pores; many prominent clay films on faces of peds; very strongly acid; clear smooth boundary.
- Bt3—29 to 40 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) mottles; few light gray (10YR 7/1) silt coats; moderate medium subangular blocky structure; very firm; few fine and very fine roots; few very fine pores; common prominent clay films on faces of peds; medium acid; clear smooth boundary.
- Bt4—40 to 48 inches; mottled yellowish brown (10YR 5/4), dark yellowish brown (10YR 4/4), and light brownish gray (10YR 6/2) silty clay loam; weak medium and fine subangular blocky structure; firm; few very fine roots; few very fine pores; common faint clay films on faces of peds; medium acid; gradual smooth boundary.
- C—48 to 62 inches; light brownish gray (10YR 6/2) silt loam; many medium distinct dark brown (7.5YR 4/4)

mottles; massive; very firm; few very fine roots;  
common very fine pores; neutral.

The solum is 46 to 60 inches thick.

The A horizon has hue of 10YR, value of 3 or 4, and  
chroma of 2 or 3. The E horizon has hue of 10YR, value

of 4 through 6, and chroma of 2 through 4. The Bt  
horizon has hue of 10YR or 7.5YR, value of 4 or 5, and  
chroma of 3 through 6. It is medium acid to very strongly  
acid. The C horizon has hue of 2.5Y or 10YR, value of 4  
through 6, and chroma of 1 through 4. There are mottles  
of high and low chroma in the B and C horizons.

# Formation of the Soils

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Soil is the product of soil-forming processes acting on accumulated or deposited geologic materials. The characteristics of any soil are determined by (1) the type of parent material, (2) plants and animals on and in the soil, (3) climate under which the soil forms, (4) relief, or lay of the land, and (5) the length of time these forces have acted.

Parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Plants and animals affect the soil's content of organic matter, its structure, and its porosity. Climate determines the amount of water available for leaching and the amount of heat, which triggers physical and chemical changes. Together, climate and plants and animals act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. Relief, in many areas, modifies these other factors. Finally, after some time, the parent material changes into soil. Generally, a long time is required for the development of distinct soil horizons.

The factors of soil formation are all so closely interrelated in their effect on the soil that few generalizations can be made about the effect of any one factor unless conditions are specified about the other four. Soil formation is complex, and many processes of soil development are still unknown.

## Parent Material

Parent material is the unconsolidated mass in which a soil forms. The characteristics of the material determine the limits of the chemical and mineralogical composition of the soil. In Marion and Ralls Counties, the soils formed in four principal kinds of parent material, alone or in combinations. These four kinds are material that weathered from bedrock, material deposited by glacial ice, material deposited by wind (loess), and material deposited by water (alluvium). Of less importance is colluvium, which was transported short distances downslope by the action of water and gravity.

The residual material is mainly from limestone and shale. Residuum of cherty limestone, for example, is the parent material of Goss soils, and weathered shale is the parent material of Gosport soils.

Glacial material, which was deposited by ice, consists mainly of clay, silt, sand, gravel, stones, and a few boulders. Much of the glacial till was moved long

distances, but some of it is of local origin. The glacial till ranges in thickness from a few feet to many feet. Armstrong and Lindley soils formed in glacial till.

Loess—silty material deposited by wind—is the most extensive parent material in the survey area. The principal source of the loess was the flood plain of the Mississippi River following the retreat of the last glacier. The deepest deposits of loess are on the hills bordering the flood plain, where it is the parent material of Menfro, Winfield, and Weller soils. Farther from the source, the windborne deposits are thinner and contain more clay. In the prairie region of the survey area, the loess was deposited on wide, nearly level or gently sloping divides. Runoff is slow on these divides, and the soils that formed there—Putnam and Mexico soils—are somewhat poorly drained and poorly drained. On narrow ridgetops, the loess deposits are thin. Gorin soils formed on those ridgetops in the loess and the underlying glacial material.

The parent material of the soils on flood plains is alluvium. Reflecting the diverse origins and the varying speeds of flowing water, this material has a great range in texture and in chemical and mineralogical composition. Local uplands are the only source of the alluvium on the flood plains of small tributary streams. The vast drainage area of the Mississippi River is the source of the parent material of soils on the Mississippi River flood plain. Soils on this flood plain, such as Carlow and Chequest soils, formed in material that washed largely from acid glacial deposits and are relatively fertile and acid in reaction.

Local streams and drainageways that flow from the uplands have deposited materials on smaller flood plains. Fatima and Blackoak soils are typical; they are high in silt from the surrounding loess-capped uplands.

## Plants and Animals

In addition to the mineral matter provided by the parent material, another important soil component is organic matter. Plants, insects, and other animals, bacteria, and fungi provide the organic matter. Plants move chemicals from the soil through their roots to their parts growing above the soil. Leaves and other plant parts later return to the soil to decay and add nutrients and organic matter. Roots loosen the soil, and when they decay they leave channels for the movement of water and air.

Native vegetation (prairie grasses and forest trees) has profoundly influenced soil formation in Marion and Ralls Counties. Prairie grasses and deciduous trees are markedly different in rooting habits, life span, and mineral composition, and the micro-organisms and animals associated with each also are significantly different.

Leaves, twigs, and logs, which tend to be acid, decompose on the soil surface and add organic matter to soils under forest. Consequently, forest soils have a very thin, dark surface layer and a leached subsurface layer.

In contrast, the organic matter added to soils under prairie grasses is largely the residue from the yearly decay of annual and biennial plants. Plant tops decompose on the surface, but much of the organic material is roots. This organic material tends to be richer in minerals than the forest residue. Thus, soils that form under prairie grasses have a much thicker, dark surface layer, and they tend to be less acid than forest soils.

Worms, insects, burrowing animals, large animals, and man affect and disturb the soils. Bacteria and fungi, however, contribute more toward the formation of soils than do animals. Bacteria and fungi cause the rotting of organic material, improve tilth, and fix nitrogen in the soil. The population of organisms in the soil is directly related to the rate of decomposition of organic material in the soil. The kinds of organisms in a given area and their activity are determined by differences in vegetation.

The activities of man, in a remarkably short time, have had a profound effect on soil formation in Marion and Ralls Counties. The major alterations have resulted from changes in vegetation, drainage, relief, and accelerated erosion. Prairie grasses have been replaced by row crops. Nearly all of the flood plains and many upland areas have been cleared and are farmed. Chemicals have been used to fertilize desirable plants and to control unwanted plants and insects. Wet soils have been drained, sloping soils have been terraced, and lime has been applied on acid soils. A new cycle of soil formation begins where huge earthmoving equipment completely rearranges soil profiles in the process of urban development. Many of these changes have increased production of food and fiber and have brought about a higher standard of living. In terms of sustained productivity, however, the net effect of man's activities has been harmful. Accelerated erosion continues to reduce the productivity of many upland soils, but man has the ability to reverse this trend. The loss of cropland to urban development is virtually irreversible.

### **Climate**

Climate has been an important factor in the formation of the soils in Marion and Ralls Counties. Climate affects the rate of geologic erosion, which, in turn, affects the shape and character of landforms. The relative abundance of plants and animals and the species

composition are altered by climatic change. Present climatic conditions favor the growth of trees instead of prairie grasses.

Changes in climate caused the glacial periods. Thousands of years of cool temperatures formed the massive glaciers that moved into the area many years ago. Warmer temperatures later resulted in severe geologic erosion and blowing of the loess that covered most of Marion and Ralls Counties at one time. Extreme changes in climate occur very slowly; therefore, there were long intermediate periods when different types of vegetation grew. Soils formed and were later covered by loess, truncated, mixed by erosion, or completely washed away. The Lindley soils, for example, formed mostly in old truncated or weathered soils.

The higher temperatures and rainfall of the present time encourage rapid chemical change and physical disintegration. If calcium carbonate and other soluble salts are removed by leaching, soil fertility declines. The present climate is also conducive to the rapid breakdown of minerals, forming clay within the soil. The clay is moved downward, forming a subsoil (B horizon). This process is known as eluviation. Nearly all soils on the uplands show these effects.

### **Relief**

Relief, or topography, refers to the lay of the land. It is closely related to patterns and forces of deposition and soil formation. Relief may be characterized by gradient (degree of slope) and by the length, shape, aspect, and uniformity of surfaces that make up a landscape. Relief is an important factor in determining the pattern and distribution of soils because of its influence on drainage, runoff, and erosion.

Relief varies greatly in Marion and Ralls Counties, ranging from nearly level to moderately sloping prairie to very steep hillsides and vertical cliffs in dissected areas.

Generally, more water enters the soil in nearly level areas than in more sloping areas. Consequently, in the nearly level areas, leaching, translocation of clay, and other soil-forming processes are intensified. Over long periods, a subsoil high in clay forms under a bleached subsurface layer. Putnam soils show this result.

At the other extreme, on very steep soils, runoff is rapid and the rate of soil formation is slow. The results of weathering are almost immediately wiped out by geologic erosion. Goss and Gosport soils formed under these conditions.

### **Time**

The "age" of a soil is not necessarily a reflection of time in years, but is rather an expression of the interaction of the soil-forming processes over periods of time. Age is determined by the degree of development of a given soil profile, not the years that the soil material

has existed. The time involved may be very short or very long.

The soils in Marion and Ralls Counties show a wide range in age. There are soils that formed in alluvium deposited by floodwaters receding from the Mississippi River flood plain. These are the youngest soils in the area. Blackoar and Landes soils are examples. At the other extreme, the soils that formed in loess and glacial till in nearly level to gently sloping areas at the highest elevations are the oldest soils in the survey area.

Putnam and Mexico soils, for example, show maximum development of distinct horizons. The carbonates originally present in their parent material have been leached to a great depth, leaving them quite acid throughout. Clay has been formed by weathering and has been translocated by water into a distinct subsoil. A highly bleached subsurface horizon generally forms if water is perched above a relatively impervious subsoil for long periods.





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# Glossary

**ABC soil.** A soil having an A, a B, and a C horizon.

**AC soil.** A soil having only an A and a C horizon.

Commonly such soil formed in recent alluvium or on steep rocky slopes.

**Aeration, soil.** The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

**Aggregate, soil.** Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

**Alluvium.** Material, such as sand, silt, or clay, deposited on land by streams.

**Area reclaim** (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

**Association, soil.** A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

**Available water capacity (available moisture capacity).** The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	<i>Inches</i>
Very low.....	0 to 3
Low.....	3 to 6
Moderate.....	6 to 9
High.....	9 to 12
Very high.....	more than 12

**Base saturation.** The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

**Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

**Bench terrace.** A raised, level or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rocks or similar material,

and designed to make the soil suitable for tillage and to prevent accelerated erosion.

**Bottom land.** The normal flood plain of a stream, subject to flooding.

**Boulders.** Rock fragments larger than 2 feet (60 centimeters) in diameter.

**Broad-base terrace.** A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

**Calcareous soil.** A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

**Capillary water.** Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

**Cation.** An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

**Cation-exchange capacity.** The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

**Chiseling.** Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

**Clay film.** A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

**Claypan.** A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

**Coarse fragments.** If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

**Coarse textured soil.** Sand or loamy sand.

**Colluvium.** Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

**Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

**Conservation tillage.** A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

**Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—  
*Loose.*—Noncoherent when dry or moist; does not hold together in a mass.

*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

*Plastic.*—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a “wire” when rolled between thumb and forefinger.

*Sticky.*—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

*Hard.*—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

*Soft.*—When dry, breaks into powder or individual grains under very slight pressure.

*Cemented.*—Hard; little affected by moistening.

**Contour stripcropping.** Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

**Control section.** The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

**Corrosive.** High risk of corrosion to uncoated steel or deterioration of concrete.

**Cover crop.** A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

**Deferred grazing.** Postponing grazing or resting grazing land for a prescribed period.

**Depth to rock** (in tables). Bedrock is too near the surface for the specified use.

**Diversion (or diversion terrace).** A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

**Drainage class** (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

*Excessively drained.*—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

*Somewhat excessively drained.*—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

*Well drained.*—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

*Moderately well drained.*—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

*Somewhat poorly drained.*—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

*Poorly drained.*—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage

results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

*Very poorly drained.*—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

**Drainage, surface.** Runoff, or surface flow of water, from an area.

**Eluviation.** The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

**Erosion.** The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

*Erosion* (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

*Erosion* (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

**Excess fines** (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

**Fast intake** (in tables). The rapid movement of water into the soil.

**Fertility, soil.** The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

**Field moisture capacity.** The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.

**Fine textured soil.** Sandy clay, silty clay, and clay.

**First bottom.** The normal flood plain of a stream, subject to frequent or occasional flooding.

**Flood plain.** A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

**Foot slope.** The inclined surface at the base of a hill.

**Frost action** (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

**Genesis, soil.** The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

**Glacial drift** (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

**Glacial till** (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

**Gleyed soil.** Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

**Grassed waterway.** A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

**Gravel.** Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

**Green manure crop** (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

**Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

**Horizon, soil.** A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

*O horizon.*—An organic layer of fresh and decaying plant residue.

*A horizon.*—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

*E horizon.*—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

*B horizon.*—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or

browner colors than those in the A horizon; or (4) a combination of these.

**C horizon.**—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

**Cr horizon.**—Soft, consolidated bedrock beneath the soil.

**R layer.**—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but can be directly below an A or a B horizon.

**Humus.** The well decomposed, more or less stable part of the organic matter in mineral soils.

**Hydrologic soil groups.** Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

**Illuviation.** The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

**Infiltration.** The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

**Infiltration rate.** The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

**Intake rate.** The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2.....	very low
0.2 to 0.4.....	low
0.4 to 0.75.....	moderately low

0.75 to 1.25.....	moderate
1.25 to 1.75.....	moderately high
1.75 to 2.5.....	high
More than 2.5.....	very high

**Irrigation.** Application of water to soils to assist in production of crops. Methods of irrigation are—

**Border.**—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

**Basin.**—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

**Controlled flooding.**—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

**Corrugation.**—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

**Drip (or trickle).**—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

**Furrow.**—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

**Sprinkler.**—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

**Subirrigation.**—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

**Wild flooding.**—Water, released at high points, is allowed to flow onto an area without controlled distribution.

**Large stones** (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

**Leaching.** The removal of soluble material from soil or other material by percolating water.

**Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.

**Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

**Loess.** Fine grained material, dominantly of silt-sized particles, deposited by wind.

**Low strength.** The soil is not strong enough to support loads.

**Medium textured soil.** Very fine sandy loam, loam, silt loam, or silt.

**Minimum tillage.** Only the tillage essential to crop production and prevention of soil damage.

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.



**Mottling, soil.** Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

**Munsell notation.** A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

**Narrow-base terrace.** A terrace no more than 4 to 8 feet wide at the base. A narrow-base terrace is similar to a broad-base terrace, except for the width of the ridge and channel.

**Neutral soil.** A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

**Nutrient, plant.** Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

**Organic matter.** Plant and animal residue in the soil in various stages of decomposition.

**Parent material.** The unconsolidated organic and mineral material in which soil forms.

**Ped.** An individual natural soil aggregate, such as a granule, a prism, or a block.

**Pediment.** Fine textured sediment that is similar in composition to the constituents of the underlying material.

**Pedon.** The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

**Percolation.** The downward movement of water through the soil.

**Percolates slowly** (in tables). The slow movement of water through the soil adversely affecting the specified use.

**Permeability.** The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow.....	less than 0.06 inch
Slow.....	0.06 to 0.2 inch
Moderately slow.....	0.2 to 0.6 inch
Moderate.....	0.6 inch to 2.0 inches
Moderately rapid.....	2.0 to 6.0 inches

Rapid.....	6.0 to 20 inches
Very rapid.....	more than 20 inches

**Phase, soil.** A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

**pH value.** A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

**Plasticity index.** The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

**Plastic limit.** The moisture content at which a soil changes from semisolid to plastic.

**Ponding.** Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

**Poorly graded.** Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

**Poor filter** (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

**Productivity, soil.** The capability of a soil for producing a specified plant or sequence of plants under specific management.

**Profile, soil.** A vertical section of the soil extending through all its horizons and into the parent material.

**Reaction, soil.** A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid.....	below 4.5
Very strongly acid.....	4.5 to 5.0
Strongly acid.....	5.1 to 5.5
Medium acid.....	5.6 to 6.0
Slightly acid.....	6.1 to 6.5
Neutral.....	6.6 to 7.3
Mildly alkaline.....	7.4 to 7.8
Moderately alkaline.....	7.9 to 8.4
Strongly alkaline.....	8.5 to 9.0
Very strongly alkaline.....	9.1 and higher

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**Residuum (residual soil material).** Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

**Rill.** A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

**Rippable.** Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

**Rock fragments.** Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

**Rooting depth** (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

**Runoff.** The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

**Sand.** As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

**Seepage** (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

**Series, soil.** A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

**Sheet erosion.** The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

**Shrink-swell.** The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

**Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

**Sinkhole.** A depression in the landscape where limestone has been dissolved.

**Site Index.** A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

**Slope** (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

**Slow intake** (in tables). The slow movement of water into the soil.

**Slow refill** (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

**Small stones** (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

**Soil.** A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent

material, as conditioned by relief over periods of time.

**Soil separates.** Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millime- ters
Very coarse sand.....	2.0 to 1.0
Coarse sand.....	1.0 to 0.5
Medium sand.....	0.5 to 0.25
Fine sand.....	0.25 to 0.10
Very fine sand.....	0.10 to 0.05
Silt.....	0.05 to 0.002
Clay.....	less than 0.002

**Solum.** The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

**Stone line.** A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

**Stones.** Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded and 6 to 15 inches (15 to 38 centimeters) in length if flat.

**Stripcropping.** Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

**Structure, soil.** The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**Substratum.** The part of the soil below the solum.

**Subsurface layer.** Any surface soil horizon (A, E, AB, or EB) below the surface layer.

**Surface layer.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

**Surface soil.** The A, E, AB, and EB horizons. Includes all subdivisions of these horizons.

**Taxadjuncts.** Soils that cannot be classified in a series recognized in the classification system. Such soils

are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

**Terrace.** An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

**Thin layer** (in tables). Otherwise suitable soil material too thin for the specified use.

**Tilth, soil.** The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

**Topsoil.** The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

**Upland** (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

**Weathering.** All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

**Well graded.** Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

**Wilting point (or permanent wilting point).** The moisture content of soil, on an oven-dry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.



# Tables

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TABLE 1.--TEMPERATURE AND PRECIPITATION  
[Recorded in the period 1951-79 at Hannibal, Missouri]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have--		Average number of growing degree days <sup>1</sup>	Average	2 years in 10 will have--		Average number of days with 0.10 inch or more	Average snowfall
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--		
	<u>°F</u>	<u>°F</u>	<u>°F</u>	<u>°F</u>	<u>°F</u>	<u>Units</u>	<u>In</u>	<u>In</u>	<u>In</u>		<u>In</u>
January----	33.4	15.4	24.4	64	-13	0	1.65	0.68	2.47	5	7.5
February---	39.4	21.0	30.2	69	-8	10	1.72	.93	2.40	5	6.2
March-----	49.8	29.9	39.9	82	6	47	3.12	1.35	4.62	7	5.1
April-----	64.4	43.2	53.8	87	23	164	3.86	2.21	5.32	8	.5
May-----	74.1	53.0	63.6	91	34	428	4.25	2.77	5.58	7	.0
June-----	82.8	62.0	72.4	95	47	672	3.83	1.84	5.54	7	.0
July-----	87.0	66.0	76.5	100	52	822	4.07	1.73	6.04	6	.0
August-----	84.9	63.8	74.4	98	50	756	3.64	1.77	5.25	6	.0
September--	78.2	56.0	67.1	96	38	513	3.60	1.29	5.51	6	.0
October----	67.3	45.0	56.2	89	26	238	3.13	1.28	4.69	5	.0
November---	51.7	32.8	42.3	76	9	23	2.03	.79	3.06	5	1.8
December---	38.8	22.1	30.5	67	-6	0	1.94	.83	2.87	5	5.4
Yearly:											
Average--	62.7	42.5	52.6	---	---	---	---	---	---	---	---
Extreme--	---	---	---	101	-13	---	---	---	---	---	---
Total----	---	---	---	---	---	3,673	36.84	28.84	44.37	72	26.5

<sup>1</sup>A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).



TABLE 2.--FREEZE DATES IN SPRING AND FALL  
 [Recorded in the period 1951-79 at Hannibal, Missouri]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 7	April 18	April 29
2 years in 10 later than--	April 3	April 14	April 24
5 years in 10 later than--	March 27	April 6	April 16
First freezing temperature in fall:			
1 year in 10 earlier than--	October 27	October 18	October 9
2 years in 10 earlier than--	November 1	October 23	October 14
5 years in 10 earlier than--	November 10	November 1	October 22

TABLE 3.--GROWING SEASON  
 [Recorded in the period 1951-79 at Hannibal,  
 Missouri]

Probability	Length of growing season if daily minimum temperature is--		
	Higher than 24° F Days	Higher than 28° F Days	Higher than 32° F Days
9 years in 10	207	189	173
8 years in 10	214	196	178
5 years in 10	227	208	189
2 years in 10	240	221	200
1 year in 10	247	227	205

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Marion County	Ralls County	Total--	
				Area	Extent
		Acres	Acres	Acres	Pct
2C2	Armstrong loam, 5 to 9 percent slopes, eroded-----	17,005	11,660	28,665	4.8
2D2	Armstrong loam, 9 to 14 percent slopes, eroded-----	19,405	13,360	32,765	5.5
4	Belknap silt loam-----	15,105	10,360	25,465	4.3
5	Blackoak silt loam-----	2,305	1,060	3,365	0.6
6	Blase silty clay-----	1,755	0	1,755	0.3
7B	Calwoods silt loam, 2 to 5 percent slopes-----	1,805	3,260	5,065	0.8
8	Carlow silty clay-----	12,905	670	13,575	2.3
9	Cedargap silt loam-----	3,155	4,310	7,465	1.3
10	Chariton silt loam-----	2,355	3,260	5,615	0.9
11	Chequest silty clay loam-----	4,655	499	5,154	0.9
12	Edina silt loam-----	2,905	412	3,317	0.6
13	Fatima silt loam-----	7,505	9,460	16,965	2.9
14B	Gifford silt loam, 2 to 5 percent slopes-----	1,105	2,560	3,665	0.6
14C	Gifford silt loam, 5 to 9 percent slopes-----	635	1,000	1,635	0.3
15C	Gorin silt loam, 5 to 9 percent slopes-----	13,305	7,410	20,715	3.5
16D	Gosport silty clay loam, 9 to 14 percent slopes-----	2,805	1,725	4,530	0.8
16E	Gosport silty clay loam, 14 to 20 percent slopes-----	1,655	2,260	3,915	0.7
17F	Goss cherty silt loam, 15 to 30 percent slopes-----	22,760	43,590	66,350	11.2
19	Landes fine sandy loam-----	8,405	4,025	12,430	2.1
20C	Leonard silt loam, 5 to 9 percent slopes-----	8,805	19,260	28,065	4.7
21E	Lindley loam, 14 to 20 percent slopes-----	6,605	1,810	8,415	1.4
21F	Lindley loam, 20 to 35 percent slopes-----	6,905	110	7,015	1.2
22B	Marion silt loam, 2 to 5 percent slopes-----	985	500	1,485	0.2
23B	Menfro silt loam, 2 to 5 percent slopes-----	4,905	1,460	6,365	1.1
23C2	Menfro silt loam, 5 to 9 percent slopes, eroded-----	14,005	3,860	17,865	3.0
23D2	Menfro silt loam, 9 to 14 percent slopes, eroded-----	9,705	4,710	14,415	2.4
23E	Menfro silt loam, 14 to 20 percent slopes-----	3,055	4,760	7,815	1.3
23F	Menfro silt loam, 20 to 35 percent slopes-----	1,705	3,510	5,215	0.9
24B2	Mexico silty clay loam, 2 to 5 percent slopes, eroded-----	24,700	42,740	67,440	11.3
25	Moniteau silt loam-----	1,505	4,710	6,215	1.0
26	Putnam silt loam-----	18,105	53,590	71,695	12.1
27C	Sampsel silty clay loam, 5 to 9 percent slopes-----	492	344	836	0.1
27D	Sampsel silty clay loam, 9 to 14 percent slopes-----	289	153	442	0.1
28B	Smileyville silt loam, 2 to 6 percent slopes-----	12,705	5,660	18,365	3.1
29B	Vigar loam, 2 to 5 percent slopes-----	2,255	670	2,925	0.5
30B	Weller silt loam, 2 to 5 percent slopes-----	2,055	3,810	5,865	1.0
31C2	Winfield silt loam, 5 to 9 percent slopes, eroded-----	10,705	19,160	29,865	5.0
31D2	Winfield silt loam, 9 to 14 percent slopes, eroded-----	7,905	13,760	21,665	3.6
32	Pits-Orthents complex-----	44	1,310	1,354	0.2
	Water-----	5,400	2,800	8,200	1.4
	Total-----	284,365	309,568	593,933	100.0

TABLE 5.--CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Capabil- ity subclass	Corn	Soybeans	Grain sorghum	Winter wheat	Grass- legume hay	Tall fescue
		<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Ton</u>	<u>AUM#</u>
2C2----- Armstrong	IIIe	59	22	50	25	2.5	5.4
2D2----- Armstrong	IVe	50	19	40	20	2.0	4.6
4----- Belknap	IIw	115	43	100	47	4.6	9.6
5----- Blackoar	IIw	100	37	85	42	4.4	9.0
6----- Blase	IIw	100	45	85	42	4.5	9.0
7B----- Calwoods	IIe	80	30	68	35	3.5	7.0
8----- Carlow	IIIw	72	26	61	30	3.3	6.6
9----- Cedargap	IIs	75	30	65	35	3.3	6.6
10----- Chariton	IIw	70	25	65	29	3.2	6.4
11----- Chequest	IIw	86	37	75	35	3.9	7.4
12----- Edina	IIw	86	33	76	35	3.4	6.7
13----- Fatima	IIw	102	38	88	42	4.5	9.0
14B----- Gifford	IIe	84	33	75	35	3.7	7.4
14C----- Gifford	IIIe	72	28	61	30	3.3	6.6
15C----- Gorin	IIIe	67	25	56	28	3.0	6.0
16D----- Gosport	VIe	---	---	---	---	2.2	4.2
16E----- Gosport	VIIe	---	---	---	---	1.5	3.0
17F----- Goss	VIIIs	---	---	---	---	---	5.0
19----- Landes	IIw	69	24	55	32	2.6	6.0
20C----- Leonard	IIIe	77	28	65	31	3.5	7.0
21E----- Lindley	VIe	---	---	---	---	2.2	4.2

See footnote at end of table.

TABLE 5.--CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Capabil- ity subclass	Corn	Soybeans	Grain sorghum	Winter wheat	Grass- legume hay	Tall fescue
		<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Ton</u>	<u>AUM*</u>
21F----- Lindley	VIe	---	---	---	---	---	4.0
22B----- Marion	IIIe	60	21	50	25	2.7	5.4
23B----- Menfro	Ile	92	35	78	38	4.0	8.0
23C2----- Menfro	IIIe	84	31	72	35	3.7	7.4
23D2----- Menfro	IIIe	74	28	60	32	3.4	6.6
23E----- Menfro	IVe	63	---	---	---	3.0	6.0
23F----- Menfro	VIe	---	---	---	---	2.7	5.4
24B2----- Mexico	IIIe	67	25	56	28	3.0	6.0
25----- Moniteau	IIIw	84	31	72	35	3.7	7.4
26----- Putnam	IIw	75	25	65	30	3.2	6.4
27C----- Sampsel	IIIe	79	30	66	30	3.0	6.0
27D----- Sampsel	IVe	69	25	59	26	2.6	5.2
28B----- Smileyville	Ile	80	30	70	32	3.5	7.0
29B----- Vigar	Ile	108	41	94	45	4.8	9.6
30B----- Weller	IIIe	84	31	72	35	4.0	7.4
31C2----- Winfield	IIIe	92	36	78	40	4.1	8.0
31D2----- Winfield	IIIe	82	32	72	35	3.7	7.4
32----- Pits-Orthents	---	---	---	---	---	---	---

\* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	
2C2, 2D2----- Armstrong	4c	Slight	Slight	Severe	Severe	White oak----- Northern red oak----	55 55	Eastern white pine, red pine, black walnut, pin oak, green ash.
4----- Belknap	2o	Slight	Slight	Slight	Slight	Eastern cottonwood-- American sycamore--- Pin oak-----	100 --- 90	Eastern cottonwood, red maple, American sycamore.
5----- Blackoar	3w	Slight	Severe	Moderate	Moderate	Pin oak----- Eastern cottonwood--	80 95	Pin oak, eastern cottonwood, pecan.
6----- Blase	3c	Slight	Moderate	Severe	Severe	Pin oak----- Pecan----- Eastern cottonwood-- Green ash-----	76 --- --- ---	Pin oak, pecan, eastern cottonwood, green ash.
7B----- Calwoods	4c	Slight	Slight	Moderate	Moderate	White oak-----	55	White oak, pin oak, green ash, black oak, bur oak.
8----- Carlow	4w	Slight	Severe	Severe	Moderate	Eastern cottonwood-- Pin oak-----	85 75	Eastern cottonwood, pin oak, pecan, green ash, silver maple.
9----- Cedargap	3f	Slight	Slight	Moderate	Slight	Black oak-----	66	Black oak.
10----- Chariton	5w	Slight	Severe	Moderate	Moderate	Pin oak-----	65	Pin oak, green ash, eastern cottonwood, silver maple.
11----- Chequest	3w	Slight	Severe	Moderate	Moderate	Eastern cottonwood-- Silver maple-----	90 80	Eastern cottonwood, silver maple, American sycamore, green ash.
13----- Fatima	2o	Slight	Slight	Slight	Slight	Pin oak-----	86	Pin oak, pecan, eastern cottonwood, American sycamore, black oak, black walnut.
14B, 14C----- Gifford	---	---	---	---	---	---	---	Pin oak, eastern cottonwood, pecan, white oak, green ash, black oak.
15C----- Gorin	4c	Slight	Slight	Moderate	Moderate	White oak-----	55	White oak, green ash, pin oak, black oak.
16D----- Gosport	5c	Slight	Moderate	Severe	Severe	White oak-----	45	Eastern white pine, white oak, black oak, northern red oak.
16E----- Gosport	5c	Moderate	Moderate	Severe	Severe	White oak-----	45	Eastern white pine, white oak, black oak, northern red oak.
17F----- Goss	4f	Slight	Severe	Moderate	Slight	White oak----- Shortleaf pine----- Post oak----- Blackjack oak----- Black oak-----	60 --- --- --- ---	Green ash.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	
19----- Landes	1o	Slight	Slight	Slight	Slight	Eastern cottonwood--- American sycamore--- Green ash-----	106 --- ---	Eastern cottonwood, American sycamore, green ash, black walnut, eastern white pine.
20C----- Leonard	5c	Slight	Slight	Severe	Severe	White oak-----	50	White oak, pin oak, green ash, yellow- poplar, black oak, bur oak.
21E, 21F----- Lindley	4r	Moderate	Moderate	Slight	Slight	White oak----- Post oak----- Blackjack oak----- Black oak----- White oak----- Post oak-----	60 --- --- --- --- ---	White oak, green ash, northern red oak, black oak, eastern white pine.
22B----- Marion	5c	Slight	Slight	Moderate	Moderate	White oak----- Post oak-----	50 ---	White oak, pin oak, green ash, eastern cottonwood, silver maple, black willow.
23B, 23C2, 23D2----- Menfro	3o	Slight	Slight	Slight	Slight	White oak----- Northern red oak---- Black oak----- White ash----- Sugar maple-----	65 75 73 70 68	Northern red oak, green ash, black walnut, black oak, white oak, eastern white pine, sugar maple.
23E, 23F----- Menfro	3r	Moderate	Moderate	Moderate	Slight	White oak----- Northern red oak---- Black oak----- White ash----- Sugar maple-----	65 75 73 70 68	Northern red oak, green ash, black walnut, black oak, white oak, eastern white pine.
24B2----- Mexico	4c	Slight	Slight	Moderate	Moderate	White oak-----	54	White oak, pin oak, green ash.
25----- Moniteau	4w	Slight	Severe	Moderate	Moderate	White oak-----	55	White oak, pin oak, green ash, eastern cottonwood, silver maple, black willow.
26----- Putnam	---	---	---	---	---	---	---	Pin oak, green ash, eastern cottonwood, white oak.
27C, 27D----- Sampsel	---	---	---	---	---	---	---	Green ash, pin oak, eastern cottonwood, pecan.
28B----- Smileyville	---	---	---	---	---	---	---	Pin oak, eastern cottonwood.
29B----- Vigar	---	---	---	---	---	---	---	Pin oak, eastern cottonwood, black walnut.
30B----- Weller	4c	Slight	Slight	Severe	Severe	White oak----- Black oak----- Northern red oak----	55 61 61	Eastern white pine, northern red oak, white oak, black walnut.
31C2, 31D2----- Winfield	3o	Slight	Slight	Slight	Slight	White oak----- Northern red oak---- Black oak-----	65 60 65	Eastern white pine, green ash, northern red oak, black oak, black walnut.



TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
2C2, 2D2----- Armstrong	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Tatarian honeysuckle, Amur honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
4----- Belknap	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce-----	Pin oak, eastern white pine.
5----- Blackoar	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
6----- Blase	---	Amur privet, Washington hawthorn, eastern redcedar, arrowwood, Amur honeysuckle, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Pin oak, eastern white pine.	---
7B----- Calwoods	---	Amur honeysuckle, Amur privet, eastern redcedar, Washington hawthorn, arrowwood, Tatarian honeysuckle, American cranberrybush.	Austrian pine, osageorange, green ash.	Pin oak, eastern white pine.	---
8----- Carlow	---	Silky dogwood, Amur honeysuckle, Amur privet, American cranberrybush.	Washington hawthorn, white fir, blue spruce, northern white-cedar, Austrian pine, Norway spruce.	Eastern white pine	Pin oak.
9----- Cedargap	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Austrian pine, northern white-cedar, white fir, Washington hawthorn, blue spruce.	Norway spruce-----	Eastern white pine, pin oak.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
10----- Chariton	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
11----- Chequest	---	Amur privet, silky dogwood, Amur honeysuckle, American cranberrybush.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
12----- Edina	---	Amur honeysuckle, Amur privet, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, blue spruce, northern white-cedar, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
13----- Fatima	---	Amur honeysuckle, Amur privet, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
14B, 14C----- Gifford	---	Amur honeysuckle, Amur privet, eastern redcedar, arrowwood, Washington hawthorn, Tatarian honeysuckle, American cranberrybush.	Green ash, Austrian pine, osageorange.	Pin oak, eastern white pine.	---
15C----- Gorin	---	Amur honeysuckle, Washington hawthorn, eastern redcedar, Amur privet, arrowwood, American cranberrybush, Tatarian honeysuckle.	Green ash, Austrian pine, osageorange.	Pin oak, eastern white pine.	---
16D, 16E----- Gosport	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
17F----- Goss	Siberian peashrub	Lilac, Amur honeysuckle, autumn-olive, Tatarian honeysuckle, eastern redcedar, Washington hawthorn, radiant crabapple.	Eastern white pine, jack pine, red pine, Austrian pine.	---	---
19----- Landes	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
20C----- Leonard	---	Amur honeysuckle, Amur privet, eastern redcedar, Tatarian honeysuckle, Washington hawthorn, arrowwood, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
21E, 21F----- Lindley	---	Silky dogwood, Amur honeysuckle, Amur privet, American cranberrybush.	Washington hawthorn, northern white-cedar, blue spruce, white fir.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
22B----- Marion	---	Amur honeysuckle, Tatarian honeysuckle, Amur privet, eastern redcedar, Washington hawthorn, arrowwood, American cranberrybush.	Austrian pine, osageorange, green ash.	Eastern white pine, pin oak.	---
23B, 23C2, 23D2, 23E, 23F----- Menfro	---	Silky dogwood, Amur honeysuckle, Amur privet, American cranberrybush.	Northern white-cedar, Washington hawthorn, blue spruce, white fir.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
24B2----- Mexico	---	Amur honeysuckle, American cranberrybush, Tatarian honeysuckle, arrowwood, eastern redcedar, Amur privet, Washington hawthorn.	Green ash, osageorange, Austrian pine.	Eastern white pine, pin oak.	---
25----- Moniteau	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
26----- Putnam	---	American cranberrybush, Amur honeysuckle, Amur privet, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
27C, 27D----- Sampsel	---	Amur honeysuckle, Amur privet, American cranberrybush, silky dogwood.	Austrian pine, northern white-cedar, white fir, blue spruce, Washington hawthorn, Norway spruce.	Eastern white pine	Pin oak.
28B----- Smileyville	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
29B----- Vigar	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
30B----- Weller	---	American cranberrybush, Tatarian honeysuckle, Amur honeysuckle, arrowwood, Washington hawthorn, Amur privet, eastern redcedar.	Osageorange, green ash, Austrian pine.	Pin oak, eastern white pine.	---
31C2, 31D2----- Winfield	---	Amur honeysuckle, Amur privet, silky dogwood, American cranberrybush.	Northern white-cedar, blue spruce, white fir, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
32*: Pits.  Orthents.					

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
2C2----- Armstrong	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
2D2----- Armstrong	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
4----- Belknap	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
5----- Blackoar	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
6----- Blase	Severe: flooding, too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
7B----- Calwoods	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
8----- Carlow	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
9----- Cedargap	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
10----- Chariton	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
11----- Chequest	Severe: wetness, flooding.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
12----- Edina	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
13----- Fatima	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
14B----- Gifford	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
14C----- Gifford	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: slope, wetness, percs slowly.	Severe: wetness.	Severe: wetness.
15C----- Gorin	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Severe: erodes easily.	Slight.
16D----- Gosport	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Moderate: slope, thin layer.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
16E----- Gosport	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Severe: slope.
17F----- Goss	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: droughty, slope.
19----- Landes	Severe: flooding.	Slight-----	Moderate: flooding.	Slight-----	Moderate: droughty, flooding.
20C----- Leonard	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight-----	Moderate: wetness.
21E----- Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
21F----- Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
22B----- Marion	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
23B----- Menfro	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
23C2----- Menfro	Slight-----	Slight-----	Severe: slope.	Slight-----	Slight.
23D2----- Menfro	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
23E----- Menfro	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
23F----- Menfro	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
24B2----- Mexico	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
25----- Moniteau	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
26----- Putnam	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
27C----- Sampsel	Severe: wetness.	Severe: wetness.	Severe: slope.	Severe: wetness.	Severe: wetness.
27D----- Sampsel	Severe: wetness.	Severe: wetness.	Severe: slope.	Severe: wetness, erodes easily.	Severe: wetness.
28B----- Smileyville	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
29B----- Vigar	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight-----	Slight.



TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
30B----- Weller	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight-----	Slight.
31C2----- Winfield	Slight-----	Slight-----	Severe: slope.	Slight-----	Slight.
31D2----- Winfield	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
32*: Pits. Orthents.					

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
2C2, 2D2----- Armstrong	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
4----- Belknap	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
5----- Blackoar	Good	Good	Good	Fair	Fair	Good	Fair	Good	Fair	Fair.
6----- Blase	Fair	Good	Good	Good	Good	Good	Good	Good	Good	Good.
7B----- Calwoods	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
8----- Carlow	Poor	Poor	Fair	Fair	Fair	Poor	Good	Poor	Fair	Fair.
9----- Cedargap	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
10----- Chariton	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
11----- Chequest	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
12----- Edina	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
13----- Fatima	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
14B, 14C----- Gifford	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
15C----- Gorin	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
16D, 16E----- Gosport	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
17F----- Goss	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
19----- Landes	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
20C----- Leonard	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
21E----- Lindley	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
21F----- Lindley	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
22B----- Marion	Fair	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
23B----- Menfro	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
23C2, 23D2----- Menfro	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
23E----- Menfro	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
23F----- Menfro	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
24B2----- Mexico	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
25----- Moniteau	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
26----- Putnam	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
27C, 27D----- Sampsel	Fair	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
28B----- Smileyville	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
29B----- Vigar	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
30B----- Weller	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
31C2, 31D2----- Winfield	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
32*: Pits.  Orthents.										

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
2C2----- Armstrong	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: low strength, frost action.	Moderate: wetness.
2D2----- Armstrong	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness.	Severe: shrink-swell, wetness, slope.	Severe: low strength, frost action.	Moderate: slope, wetness.
4----- Belknap	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Moderate: wetness, flooding.
5----- Blackoar	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
6----- Blase	Severe: wetness.	Severe: flooding, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Severe: too clayey.
7B----- Calwoods	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
8----- Carlow	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, flooding.	Severe: wetness, too clayey.
9----- Cedargap	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
10----- Chariton	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, frost action.	Severe: wetness.
11----- Chequest	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
12----- Edina	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
13----- Fatima	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Severe: flooding.
14B, 14C----- Gifford	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
15C----- Gorin	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Slight.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
16D----- Gosport	Moderate: depth to rock, too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope, thin layer.
16E----- Gosport	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
17F----- Goss	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
19----- Landes	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
20C----- Leonard	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
21E, 21F----- Lindley	Severe: wetness, slope.	Severe: slope.	Severe: wetness, slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
22B----- Marion	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Moderate: wetness.
23B----- Menfro	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
23C2----- Menfro	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
23D2----- Menfro	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
23E, 23F----- Menfro	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: frost action, low strength, slope.	Severe: slope.
24B2----- Mexico	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Moderate: wetness.
25----- Moniteau	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, wetness.	Severe: wetness.
26----- Putnam	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
27C----- Sampsel	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness.	Severe: low strength, frost action, wetness.	Severe: wetness.
27D----- Sampsel	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, slope, wetness.	Severe: low strength, frost action, wetness.	Severe: wetness.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
28B----- Smileyville	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, frost action.	Severe: wetness.
29B----- Vigar	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
30B----- Weller	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: shrink-swell, frost action, low strength.	Slight.
31C2----- Winfield	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
31D2----- Winfield	Moderate: wetness, slope.	Moderate: shrink-swell, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
32*: Pits.  Orthents.						

\* See description of the map unit for composition and behavior characteristics of the map unit.



TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2C2, 2D2----- Armstrong	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
4----- Belknap	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
5----- Blackoar	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
6----- Blase	Severe: wetness, percs slowly.	Slight-----	Severe: wetness, too clayey.	Moderate: flooding, wetness.	Poor: too clayey, hard to pack.
7B----- Calwoods	Severe: wetness, percs slowly.	Slight-----	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
8----- Carlow	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
9----- Cedargap	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Poor: small stones.
10----- Chariton	Severe: wetness, percs slowly.	Slight-----	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
11----- Chequest	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness, hard to pack.
12----- Edina	Severe: wetness, percs slowly.	Slight-----	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
13----- Fatima	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
14B----- Gifford	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
14C----- Gifford	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
15C----- Gorin	Severe: wetness, percs slowly.	Severe: slope.	Moderate: wetness, too clayey.	Moderate: wetness.	Poor: thin layer.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
16D----- Gosport	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, hard to pack.
16E----- Gosport	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, hard to pack, slope.
17F----- Goss	Severe: slope.	Severe: seepage, slope.	Severe: slope, too clayey, large stones.	Severe: seepage, slope.	Poor: too clayey, small stones, slope.
19----- Landes	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage.	Poor: seepage, too sandy.
20C----- Leonard	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
21E, 21F----- Lindley	Severe: wetness, percs slowly, slope.	Severe: slope, wetness.	Severe: wetness, slope.	Severe: wetness, slope.	Poor: slope.
22B----- Marion	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
23B----- Menfro	Slight-----	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----	Fair: too clayey.
23C2----- Menfro	Slight-----	Severe: slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
23D2----- Menfro	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
23E, 23F----- Menfro	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
24B2----- Mexico	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
25----- Moniteau	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
26----- Putnam	Severe: wetness, percs slowly.	Slight-----	Severe: wetness.	Severe: wetness.	Poor: wetness, hard to pack.
27C, 27D----- Sampsel	Severe: wetness, percs slowly.	Severe: slope.	Severe: depth to rock, wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
28B----- Smileyville	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
29B----- Vigar	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
30B----- Weller	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, hard to pack.
31C2----- Winfield	Severe: wetness.	Severe: slope, wetness.	Moderate: wetness, too clayey.	Moderate: wetness.	Fair: too clayey, wetness.
31D2----- Winfield	Severe: wetness.	Severe: slope, wetness.	Moderate: wetness, slope, too clayey.	Moderate: wetness, slope.	Fair: too clayey, slope, wetness.
32*: Pits.  Orthents.					

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
2C2, 2D2----- Armstrong	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
4----- Belknap	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
5----- Blackoar	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
6----- Blase	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
7B----- Calwoods	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
8----- Carlow	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
9----- Cedargap	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
10----- Chariton	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
11----- Chequest	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
12----- Edina	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
13----- Fatima	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
14B, 14C----- Gifford	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
15C----- Gorin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
16D----- Gosport	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
16E----- Gosport	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
17F----- Goss	Fair: low strength, large stones, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
19----- Landes	Good-----	Probable-----	Improbable: too sandy.	Poor: thin layer.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
20C----- Leonard	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
21E----- Lindley	Fair: wetness, slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
21F----- Lindley	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
22B----- Marion	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
23B, 23C2----- Menfro	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
23D2----- Menfro	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, too clayey.
23E----- Menfro	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
23F----- Menfro	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
24B2----- Mexico	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
25----- Moniteau	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
26----- Putnam	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
27C, 27D----- Sampsel	Poor: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
28B----- Smileyville	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
29B----- Vigar	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
30B----- Weller	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
31C2----- Winfield	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
31D2----- Winfield	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
32*: Pits.  Orthents.				

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
2C2----- Armstrong	Moderate: slope.	Moderate: wetness.	Peres slowly, frost action, slope.	Wetness, peres slowly, slope.	Peres slowly, wetness.	Peres slowly, wetness.
2D2----- Armstrong	Severe: slope.	Moderate: wetness.	Peres slowly, frost action, slope.	Wetness, peres slowly, slope.	Slope, peres slowly, wetness.	Peres slowly, slope, wetness.
4----- Belknap	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, erodes easily, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
5----- Blackoar	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness-----	Wetness.
6----- Blase	Moderate: seepage.	Severe: thin layer.	Peres slowly, frost action.	Wetness, slow intake, peres slowly.	Wetness, peres slowly.	Peres slowly.
7B----- Calwoods	Moderate: slope.	Severe: hard to pack.	Peres slowly, frost action, slope.	Wetness, peres slowly, slope.	Erodes easily, wetness, peres slowly.	Wetness, erodes easily, peres slowly.
8----- Carlow	Slight-----	Severe: hard to pack, wetness.	Peres slowly, flooding.	Wetness, droughty, slow intake.	Erodes easily, wetness, peres slowly.	Wetness, erodes easily, droughty.
9----- Cedargap	Severe: seepage.	Severe: seepage.	Deep to water	Flooding-----	Large stones---	Favorable.
10----- Chariton	Moderate: seepage.	Severe: wetness.	Peres slowly, frost action.	Wetness, peres slowly, erodes easily.	Erodes easily, wetness, peres slowly.	Wetness, erodes easily, peres slowly.
11----- Chequest	Slight-----	Severe: wetness.	Flooding, frost action.	Flooding, wetness.	Wetness, erodes easily.	Wetness, erodes easily.
12----- Edina	Slight-----	Severe: hard to pack, wetness.	Peres slowly---	Wetness, peres slowly.	Erodes easily, wetness, peres slowly.	Wetness, erodes easily, peres slowly.
13----- Fatima	Moderate: seepage.	Moderate: thin layer, piping, wetness.	Deep to water	Flooding-----	Favorable-----	Favorable.
14B, 14C----- Gifford	Moderate: slope.	Severe: wetness.	Peres slowly, slope.	Wetness, peres slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.
15C----- Gorin	Moderate: slope.	Moderate: thin layer, piping, wetness.	Peres slowly, frost action, slope.	Wetness, peres slowly, slope.	Erodes easily, wetness.	Erodes easily, peres slowly.
16D, 16E----- Gosport	Severe: slope.	Severe: hard to pack.	Deep to water	Peres slowly, depth to rock, rooting depth.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
17F----- Goss	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
19----- Landes	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, flooding.	Too sandy, soil blowing.	Droughty.



TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
20C----- Leonard	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Erodes easily, percs slowly.
21E, 21F----- Lindley	Severe: slope.	Moderate: piping, wetness.	Slope-----	Wetness, slope.	Slope, wetness.	Slope.
22B----- Marion	Moderate: slope.	Moderate: wetness.	Percs slowly, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
23B, 23C2----- Menfro	Moderate: slope, seepage.	Slight-----	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
23D2, 23E, 23F----- Menfro	Severe: slope.	Slight-----	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
24B2----- Mexico	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
25----- Moniteau	Slight-----	Severe: wetness.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
26----- Putnam	Slight-----	Severe: wetness.	Percs slowly---	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
27C----- Sampsel	Moderate: depth to rock, slope.	Severe: hard to pack, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Erodes easily, wetness.
27D----- Sampsel	Severe: slope.	Severe: hard to pack, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Slope, erodes easily, wetness.	Slope, erodes easily, wetness.
28B----- Smileyville	Moderate: slope.	Severe: wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.
29B----- Vigar	Moderate: slope.	Moderate: wetness.	Frost action, slope.	Wetness, slope.	Wetness-----	Favorable.
30B----- Weller	Moderate: slope.	Moderate: hard to pack, wetness.	Slope, percs slowly, frost action.	Wetness, percs slowly, slope.	Wetness, erodes easily.	Percs slowly, erodes easily.
31C2----- Winfield	Moderate: seepage, slope.	Moderate: thin layer, wetness.	Frost action, slope.	Wetness, slope, erodes easily.	Erodes easily, wetness.	Erodes easily.
31D2----- Winfield	Severe: slope.	Moderate: thin layer, wetness.	Frost action, slope.	Wetness, slope, erodes easily.	Slope, erodes easily, wetness.	Slope, erodes easily.
32*: Pits. Orthents.						

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol &lt; means less than; &gt; means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>				<u>Pct</u>					<u>Pct</u>	
2C2, 2D2----- Armstrong	0-6	Loam-----	CL, CL-ML	A-6, A-4	0-5	90-100	80-95	75-90	55-80	20-30	5-15
	6-62	Clay loam, clay, silty clay loam.	CL, CH	A-7	0-5	90-100	80-95	70-90	55-80	45-60	20-30
4----- Belknap	0-7	Silt loam-----	ML, CL, CL-ML	A-4	0	100	95-100	90-100	80-100	20-30	2-8
	7-68	Silt loam-----	ML, CL-ML, CL	A-4, A-6	0	100	95-100	90-100	80-100	20-35	NP-12
5----- Blackoar	0-65	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-18
6----- Blase	0-9	Silty clay-----	CL, CH	A-7	0	100	100	95-100	90-95	45-65	30-45
	9-35	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	85-100	40-65	25-40
	35-65	Loam, silt loam	CL, CL-ML	A-4, A-6	0	100	100	85-95	60-80	20-30	5-15
7B----- Calwoods	0-8	Silt loam-----	CL-ML, CL	A-4	0	100	100	95-100	90-100	25-32	5-10
	8-13	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	23-35
	13-42	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	55-70	30-45
	42-62	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	95-100	95-100	38-50	22-28
8----- Carlow	0-12	Silty clay-----	CL, CH	A-7	0	100	100	95-100	95-100	40-65	25-40
	12-65	Silty clay, clay	CL, CH	A-7	0	100	100	95-100	95-100	45-75	30-50
9----- Cedargap	0-17	Silt loam-----	ML	A-4	0-5	90-100	85-95	75-95	70-95	25-35	3-9
	17-38	Cherty silt loam, extremely cherty loam, very cherty silt loam.	SM, GM	A-1, A-2, A-4	2-15	40-85	20-50	15-45	15-40	25-35	3-9
	38-68	Cherty silt loam, extremely cherty silty clay loam, cherty clay loam.	GC	A-2-6, A-6	5-20	25-50	20-50	15-45	15-40	30-40	15-25
10----- Chariton	0-16	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	90-100	70-90	25-35	5-15
	16-32	Silty clay-----	CH	A-7	0	100	100	95-100	90-95	50-60	30-40
	32-50	Silty clay loam	CL	A-7	0	100	100	95-100	85-95	40-45	20-25
	50-63	Sandy clay loam, fine sandy loam, silt loam.	CL, SC, CL-ML, SM-SC	A-6, A-4	0	100	100	80-95	40-70	20-35	5-20
11----- Chequest	0-13	Silty clay loam	CL	A-7	0	100	100	98-100	95-100	40-50	15-25
	13-65	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	98-100	90-100	45-60	20-30
12----- Edina	0-18	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-100	25-40	5-15
	18-59	Silty clay-----	CH	A-7	0	100	100	95-100	90-100	55-75	30-45
	59-63	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	90-100	35-60	15-35
13----- Fatima	0-18	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-100	25-40	5-18
	18-50	Silt loam-----	CL	A-6	0	100	100	95-100	90-100	30-40	12-18
	50-68	Silt loam, loam	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-100	25-40	5-18
14B, 14C----- Gifford	0-8	Silt loam-----	CL	A-6	0	100	100	90-100	85-95	30-40	10-20
	8-36	Silty clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	95-100	50-65	30-40
	36-65	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	85-100	75-90	35-45	20-25

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches Pct	Percentage passing sieve number--				Liquid limit Pct	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In										
15C----- Gorin	0-8	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-18
	8-13	Silty clay loam, silty clay.	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	15-30
	13-32	Silty clay-----	CH	A-7	0	100	100	95-100	90-100	50-65	30-40
	32-67	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	80-95	70-90	30-50	12-30
16D, 16E----- Gosport	0-4	Silty clay loam	ML, MH	A-7	0	100	100	95-100	85-100	41-55	11-20
	4-29	Clay, silty clay	CH	A-7	0	100	100	95-100	85-100	50-65	35-50
	29-62	Weathered bedrock	CH	A-7	0	100	100	95-100	85-100	65-80	50-60
17F----- Goss	0-5	Cherty silt loam	ML, CL, CL-ML	A-4	0-10	65-90	65-90	65-90	65-85	20-30	2-8
	5-62	Cherty silty clay loam, cherty silty clay, cherty clay.	GC	A-7	10-45	45-70	40-65	40-50	35-45	50-70	30-40
19----- Landes	0-7	Fine sandy loam	SM, SC, SM-SC	A-4, A-2	0	100	95-100	85-95	20-50	<25	NP-10
	7-60	Stratified fine sand to silt loam.	SM, SP-SM, SC	A-4	0	100	100	70-90	40-50	<25	NP-15
20C----- Leonard	0-8	Silt loam-----	CL	A-6, A-7	0	100	95-100	90-100	85-100	30-45	15-25
	8-14	Silty clay loam, silty clay.	CL	A-6, A-7	0	100	95-100	90-100	85-100	35-50	20-30
	14-65	Silty clay, clay	CH	A-7	0	100	95-100	85-100	80-100	55-70	30-40
21E, 21F----- Lindley	0-6	Loam-----	CL	A-6	0	95-100	90-100	85-95	50-65	25-35	10-15
	6-31	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	10-20
	31-67	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	25-35	10-15
22B----- Marion	0-13	Silt loam-----	ML, CL	A-4, A-6	0	100	100	90-100	90-100	30-40	5-15
	13-32	Silty clay-----	CH	A-7	0	100	100	95-100	90-100	50-65	30-40
	32-63	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	35-45	20-25
23B, 23C2, 23D2, 23E, 23F----- Menfro	0-9	Silt loam-----	CL	A-6	0	100	100	95-100	92-100	25-35	11-20
	9-58	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-45	20-25
	58-65	Silt loam, silty clay loam.	CL-ML, CL	A-4, A-6	0	100	100	95-100	92-100	25-35	5-15
24B2----- Mexico	0-8	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	95-100	90-100	40-55	15-25
	8-28	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	55-70	30-45
	28-66	Silty clay loam, clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-100	40-65	15-40
25----- Moniteau	0-17	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	90-100	85-100	25-35	5-15
	17-45	Silty clay loam	CL	A-6, A-7	0	100	100	85-100	80-95	30-45	15-25
	45-64	Silt loam-----	CL-ML, CL, ML	A-4	0	100	100	85-100	75-100	25-35	5-10
26----- Putnam	0-16	Silt loam-----	CL	A-6, A-7	0	100	100	90-100	85-100	30-45	10-20
	16-35	Silty clay-----	CH	A-7	0	100	100	95-100	90-100	60-70	35-45
	35-48	Silty clay loam	CL, CH	A-7	0	100	100	95-100	90-100	40-55	20-35
	48-62	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	20-30
27C, 27D----- Sampsel	0-13	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-99	35-50	15-25
	13-65	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	97-100	95-100	52-75	35-47
28B----- Smileyville	0-14	Silt loam-----	CL	A-4, A-6	0	100	100	90-100	90-100	25-35	8-15
	14-39	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	55-65	30-40
	39-63	Silty clay loam	CH	A-7	0	100	100	95-100	95-100	50-60	28-35
29B----- Vigar	0-12	Loam-----	CL-ML, CL	A-4, A-6	0	95-100	90-100	85-95	60-75	20-30	5-15
	12-62	Clay loam, silty clay loam.	CL	A-6	0	95-100	90-100	80-95	70-90	30-40	15-25

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches  Pct	Percentage passing sieve number--				Liquid limit  Pct	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
30B----- Weller	<u>In</u>										
	0-14	Silt loam-----	ML, CL	A-6, A-4	0	100	100	100	95-100	30-40	5-15
	14-52	Silty clay loam, silty clay.	CH	A-7	0	100	100	100	95-100	50-65	30-40
	52-63	Silty clay loam, silt loam.	CH, CL	A-7	0	100	100	100	95-100	45-55	20-30
31C2, 31D2----- Winfield	0-16	Silt loam-----	CL	A-6	0	100	100	95-100	90-100	25-40	10-20
	16-48	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-45	20-25
	48-62	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-35	5-15
32*: Pits.  Orthents.											

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
	In	Pct	G/cm <sup>3</sup>	In/hr	In/in	pH	Mmhos/cm		K	T		
2C2, 2D2----- Armstrong	0-6	22-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	<2	Moderate	0.32	3	6	2-3
	6-62	36-48	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	<2	High-----	0.32			
4----- Belknap	0-7	8-18	1.30-1.50	0.2-2.0	0.22-0.24	4.5-7.3	<2	Low-----	0.37	5	5	1-3
	7-68	8-25	1.25-1.50	0.2-2.0	0.20-0.22	4.5-7.3	<2	Low-----	0.37			
5----- Blackoar	0-65	18-27	1.35-1.45	0.6-2.0	0.20-0.24	5.6-7.3	<2	Low-----	0.28	5	6	2-4
6----- Blase	0-9	40-60	1.30-1.45	0.06-0.2	0.12-0.14	5.6-6.0	<2	High-----	0.28	5	4	2-4
	9-35	35-60	1.30-1.45	0.06-0.2	0.12-0.21	5.6-6.0	<2	High-----	0.28			
	35-65	7-20	1.30-1.45	0.6-2.0	0.18-0.20	6.6-7.8	<2	Low-----	0.28			
7B----- Calwoods	0-8	15-27	1.40-1.50	0.6-2.0	0.22-0.24	4.5-7.3	<2	Low-----	0.43	3	6	1-2
	8-13	28-39	1.35-1.45	0.2-0.6	0.18-0.20	4.5-5.5	<2	Moderate	0.32			
	13-42	45-60	1.30-1.35	<0.06	0.11-0.13	4.5-5.5	<2	High-----	0.32			
	42-62	28-39	1.35-1.45	<0.06	0.14-0.18	4.5-6.0	<2	High-----	0.32			
8----- Carlow	0-12	40-50	1.30-1.40	0.06-0.2	0.12-0.14	5.1-6.0	<2	High-----	0.37	5	4	2-4
	12-65	45-60	1.25-1.35	<0.06	0.09-0.12	4.5-6.0	<2	High-----	0.37			
9----- Cedargap	0-17	15-27	1.20-1.40	0.6-2.0	0.22-0.24	5.6-7.3	<2	Low-----	0.32	5	6	1-4
	17-38	12-27	1.30-1.50	2.0-6.0	0.10-0.15	5.6-7.3	<2	Low-----	0.24			
	38-68	25-35	1.40-1.55	2.0-6.0	0.04-0.10	5.6-7.3	<2	Low-----	0.24			
10----- Chariton	0-16	15-27	1.35-1.50	0.6-2.0	0.22-0.24	4.5-6.5	<2	Low-----	0.43	3	6	1-4
	16-32	48-60	1.35-1.45	0.06-0.2	0.11-0.13	5.1-7.3	<2	High-----	0.28			
	32-50	35-40	1.35-1.45	0.2-0.6	0.18-0.20	6.1-7.8	<2	Moderate	0.43			
	50-63	15-35	1.40-1.55	0.6-2.0	0.15-0.18	6.1-7.8	<2	Moderate	0.32			
11----- Chequest	0-13	30-35	1.30-1.35	0.2-0.6	0.18-0.20	5.6-7.3	<2	High-----	0.28	5	7	3-4
	13-65	35-42	1.35-1.45	0.2-0.6	0.14-0.18	5.1-6.0	<2	High-----	0.43			
12----- Edina	0-18	15-27	1.35-1.45	0.6-2.0	0.22-0.24	5.1-7.3	<2	Moderate	0.37	4	6	1-4
	18-59	45-60	1.30-1.45	<0.06	0.11-0.13	5.6-7.3	<2	Very high	0.37			
	59-63	27-40	1.35-1.50	0.06-0.2	0.18-0.20	6.6-7.3	<2	High-----	0.37			
13----- Fatima	0-18	15-30	1.30-1.45	0.6-2.0	0.22-0.24	6.1-7.3	<2	Low-----	0.28	5	6	2-4
	18-50	18-27	1.35-1.55	0.6-2.0	0.20-0.22	6.1-7.3	<2	Low-----	0.28			
	50-68	18-27	1.35-1.55	0.6-2.0	0.20-0.22	6.1-7.3	<2	Low-----	0.28			
14B, 14C----- Gifford	0-8	20-35	1.30-1.45	0.6-2.0	0.22-0.24	5.1-7.3	<2	Low-----	0.43	3	6	1-4
	8-36	45-60	1.30-1.45	<0.06	0.11-0.14	5.1-6.5	<2	High-----	0.32			
	36-65	27-35	1.35-1.50	0.06-0.2	0.18-0.20	5.6-7.3	<2	Moderate	0.43			
15C----- Gorin	0-8	12-27	1.30-1.50	0.6-2.0	0.22-0.24	5.1-7.3	<2	Moderate	0.43	3	6	.5-1
	8-13	27-43	1.30-1.45	0.06-0.2	0.18-0.20	5.1-6.0	<2	Moderate	0.32			
	13-32	45-60	1.30-1.40	0.06-0.2	0.11-0.13	5.1-6.0	<2	High-----	0.32			
	32-67	27-40	1.30-1.45	0.2-0.6	0.18-0.20	5.1-6.0	<2	Moderate	0.32			
16D, 16E----- Gosport	0-4	27-34	1.30-1.40	0.2-0.6	0.14-0.16	5.1-7.3	<2	Moderate	0.43	2	4	1-2
	4-29	40-60	1.50-1.60	<0.06	0.12-0.14	3.6-5.5	<2	High-----	0.32			
	29-62	40-75	1.70-1.90	<0.06	0.08-0.10	4.0-5.0	<2	High-----				
17F----- Goss	0-5	7-27	1.10-1.30	2.0-6.0	0.06-0.17	4.5-7.3	<2	Low-----	0.24	2	6	1-2
	5-62	35-60	1.30-1.50	0.6-2.0	0.04-0.09	4.5-6.0	<2	Moderate	0.24			
19----- Landes	0-7	5-20	1.40-1.60	2.0-6.0	0.10-0.18	6.1-8.4	<2	Low-----	0.20	5	3	1-2
	7-60	8-18	1.60-1.80	2.0-6.0	0.05-0.15	6.1-8.4	<2	Low-----	0.20			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

[illegible]



TABLE 16.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
2C2, 2D2----- Armstrong	D	None-----	---	---	<u>Ft</u> 1.0-3.0	Perched	Nov-Jul	<u>In</u> >60	---	High-----	High-----	Moderate.
4----- Belknap	C	Occasional	Brief to long.	Mar-Jun	1.0-3.0	Apparent	Mar-Jun	>60	---	High-----	High-----	High.
5----- Blackoar	B/D	Occasional	Brief to long.	Nov-May	0-1.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
6----- Blase	C	Rare-----	---	---	1.5-3.0	Perched	Jan-Apr	>60	---	High-----	High-----	Moderate.
7B----- Calwoods	D	None-----	---	---	1.0-2.5	Perched	Nov-Apr	>60	---	High-----	High-----	High.
8----- Carlow	D	Occasional	Brief to long.	Apr-Jun	0-1.0	Apparent	Nov-Mar	>60	---	Moderate	High-----	Moderate.
9----- Cedargap	B	Frequent----	Very brief	Nov-Mar	>6.0	---	---	>60	---	Moderate	Low-----	Low.
10----- Chariton	C	Rare-----	---	---	0-1.5	Perched	Nov-May	>60	---	High-----	High-----	Moderate.
11----- Chequest	C	Occasional	Brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
12----- Edina	D	None-----	---	---	0.5-2.0	Perched	Nov-Apr	>60	---	Moderate	High-----	Moderate.
13----- Fatima	B	Frequent----	Brief-----	Apr-Jul	3.0-5.0	Apparent	Nov-Apr	>60	---	High-----	Moderate	Low.
14B, 14C----- Gifford	D	Rare-----	---	---	.5-2.0	Perched	Nov-Apr	>60	---	Moderate	High-----	Moderate.
15C----- Gorin	C	None-----	---	---	2.0-4.0	Perched	Nov-Apr	>60	---	High-----	High-----	Moderate.
16D, 16E----- Gosport	C	None-----	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	High.
17F----- Goss	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
19----- Landes	B	Occasional	Brief-----	Jan-Apr	4.0-6.0	Apparent	Mar-May	>60	---	Moderate	Low-----	Low.
20C----- Leonard	D	None-----	---	---	.5-2.0	Perched	Nov-Apr	>60	---	High-----	High-----	Moderate.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					<u>Ft</u>			<u>In</u>				
21E, 21F----- Lindley	C	None-----	---	---	2.0-3.5	Apparent	Nov-Apr	>60	---	Moderate	Moderate	Moderate.
22B----- Marion	D	None-----	---	---	1.0-2.0	Perched	Nov-May	>60	---	Moderate	High-----	High.
23B, 23C2, 23D2, 23E, 23F----- Menfro	B	None-----	---	---	>6.0	---	---	>60	---	High-----	Low-----	Moderate.
24B2----- Mexico	D	None-----	---	---	1.0-2.5	Perched	Nov-Apr	>60	---	Moderate	High-----	Moderate.
25----- Moniteau	C/D	Occasional	Brief-----	Apr-May	0-1.0	Perched	Nov-May	>60	---	High-----	High-----	High.
26----- Putnam	D	None-----	---	---	0.5-1.5	Perched	Nov-May	>60	---	Moderate	High-----	High.
27C, 27D----- Sampsel	D	None-----	---	---	0-1.5	Perched	Nov-Apr	40-70	Soft	High-----	High-----	Low.
28B----- Smileyville	D	None-----	---	---	0.5-1.5	Perched	Nov-May	>60	---	High-----	High-----	Moderate.
29B----- Vigar	C	None-----	---	---	2.0-3.0	Apparent	Nov-Apr	>60	---	High-----	High-----	Moderate.
30B----- Weller	C	None-----	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	High.
31C2, 31D2----- Winfield	B	None-----	---	---	2.5-4.0	Apparent	Nov-Apr	>60	---	High-----	Moderate	Moderate.
32*: Pits.  Orthents.												

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Armstrong-----	Fine, montmorillonitic, mesic Aquollic Hapludalfs
Belknap-----	Coarse-silty, mixed, acid, mesic Aeric Fluvaquents
Blackbar-----	Fine-silty, mixed, mesic Fluvaquentic Haplaquolls
Blase-----	Clayey over loamy, montmorillonitic, mesic Aquic Hapludolls
Calwoods-----	Fine, montmorillonitic, mesic Aeric Ochraqualfs
Carlow-----	Fine, montmorillonitic, mesic Vertic Haplaquolls
Cedargap-----	Loamy-skeletal, mixed, mesic Cumulic Hapludolls
Chariton-----	Fine, montmorillonitic, mesic Mollic Albaqualfs
Chequest-----	Fine, montmorillonitic, mesic Typic Haplaquolls
Edina-----	Fine, montmorillonitic, mesic Typic Argialbolls
Fatima-----	Fine-silty, mixed, mesic Fluvaquentic Hapludolls
Gifford-----	Fine, montmorillonitic, mesic Vertic Ochraqualfs
Gorin-----	Fine, montmorillonitic, mesic Aquic Hapludalfs
*Gosport-----	Fine, illitic, mesic Typic Dystrochrepts
Goss-----	Clayey-skeletal, mixed, mesic Typic Paleudalfs
Landes-----	Coarse-loamy, mixed, mesic Fluventic Hapludolls
Leonard-----	Fine, montmorillonitic, mesic Vertic Ochraqualfs
Lindley-----	Fine-loamy, mixed, mesic Typic Hapludalfs
Marion-----	Fine, montmorillonitic, mesic Albaquic Hapludalfs
Menfro-----	Fine-silty, mixed, mesic Typic Hapludalfs
Mexico-----	Fine, montmorillonitic, mesic Udollic Ochraqualfs
Moniteau-----	Fine-silty, mixed, mesic Typic Ochraqualfs
Orthents-----	Clayey-skeletal, mixed, mesic Udorthents
Putnam-----	Fine, montmorillonitic, mesic Mollic Albaqualfs
Sampsel-----	Fine, montmorillonitic, mesic, sloping Typic Argiaquolls
Smileyville-----	Fine, montmorillonitic, mesic Mollic Albaqualfs
Vigar-----	Fine-loamy, mixed, mesic Aquic Argiudolls
Weller-----	Fine, montmorillonitic, mesic Aquic Hapludalfs
Winfield-----	Fine-silty, mixed, mesic Typic Hapludalfs

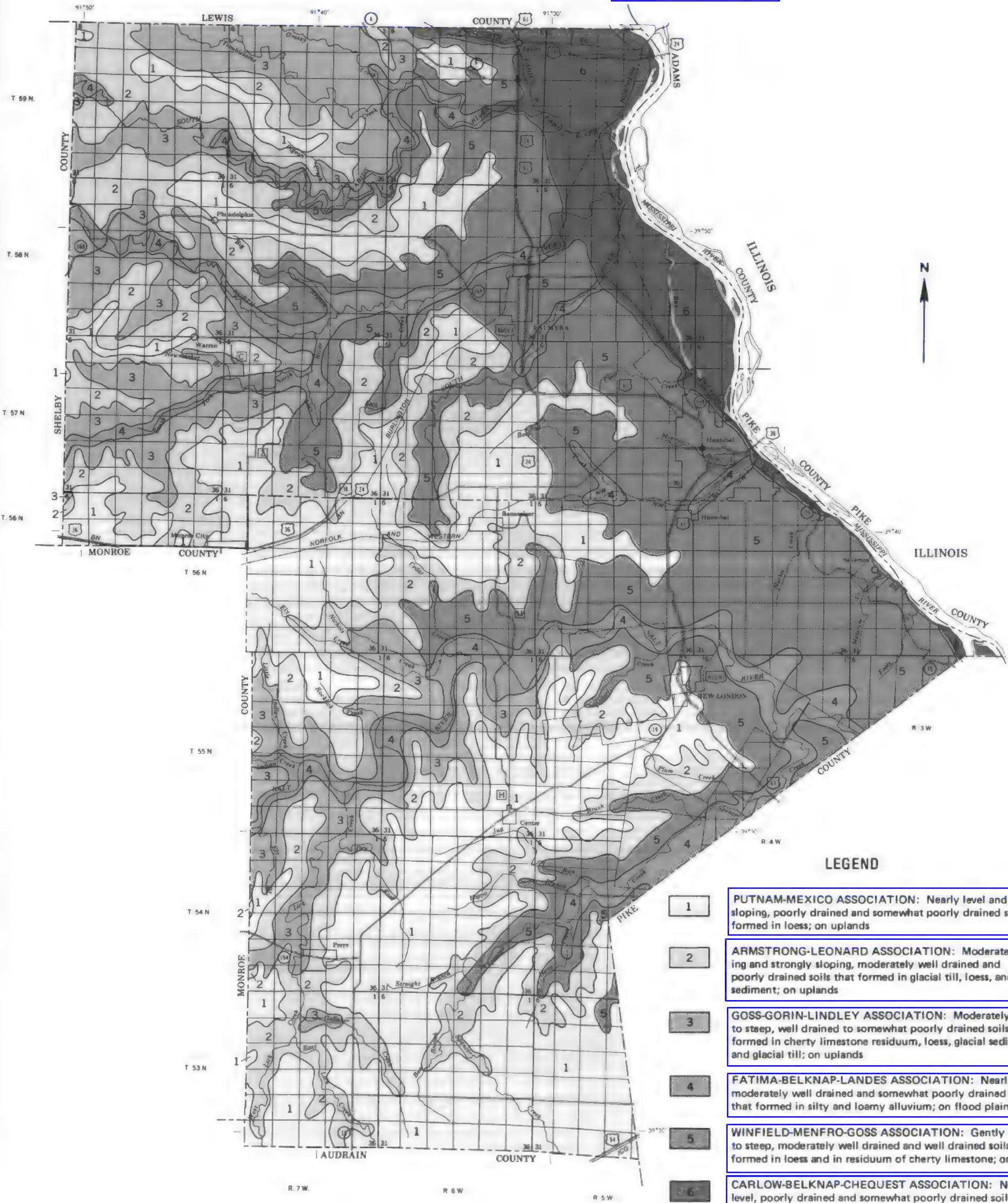
\* The soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series.

# Accessibility Statement

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LEGEND

- 1 PUTNAM-MEXICO ASSOCIATION: Nearly level and gently sloping, poorly drained and somewhat poorly drained soils that formed in loess; on uplands
- 2 ARMSTRONG-LEONARD ASSOCIATION: Moderately sloping and strongly sloping, moderately well drained and poorly drained soils that formed in glacial till, loess, and pedisegment; on uplands
- 3 GOSS-GORIN-LINDLEY ASSOCIATION: Moderately sloping to steep, well drained to somewhat poorly drained soils that formed in cherty limestone residuum, loess, glacial sediment, and glacial till; on uplands
- 4 FATIMA-BELKNAP-LANDES ASSOCIATION: Nearly level, moderately well drained and somewhat poorly drained soils that formed in silty and loamy alluvium; on flood plains
- 5 WINFIELD-MENFRO-GOSS ASSOCIATION: Gently sloping to steep, moderately well drained and well drained soils that formed in loess and in residuum of cherty limestone; on uplands
- 6 CARLOW-BELKNAP-CHEQUEST ASSOCIATION: Nearly level, poorly drained and somewhat poorly drained soils that formed in clayey and silty alluvium; on flood plains

Compiled 1983

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE  
MISSOURI AGRICULTURAL EXPERIMENT STATION

**GENERAL SOIL MAP**  
**MARION AND RALLS COUNTIES, MISSOURI**

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

SECTIONALIZED  
TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.





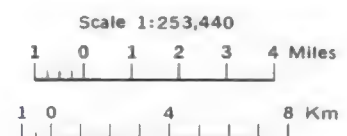
General Soil Map

Welcome Page

Manuscript

SECTIONALIZED TOWNSHIP					
6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

# INDEX TO MAP SHEETS MARION AND RALLS COUNTIES, MISSOURI



SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and a letter. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 following the slope letter indicates that the soil is eroded.

SYMBOL	NAME
2C2	Armstrong loam, 5 to 9 percent slopes, eroded
2D2	Armstrong loam, 9 to 14 percent slopes, eroded
4	Belknap silt loam
5	Blackoer silt loam
6	Blase silty clay
7B	Calwoods silt loam, 2 to 5 percent slopes
8	Carlrow silty clay
9	Cedargap silt loam
10	Chariton silt loam
11	Chequest silty clay loam
12	Edina silt loam
13	Fatima silt loam
14B	Gifford silt loam, 2 to 5 percent slopes
14C	Gifford silt loam, 5 to 9 percent slopes
15C	Gorin silt loam, 5 to 9 percent slopes
16D	Gosport silty clay loam, 9 to 14 percent slopes
16E	Gosport silty clay loam, 14 to 20 percent slopes
17F	Goss cherty silt loam, 15 to 30 percent slopes
19	Landes fine sandy loam
20C	Leonard silt loam, 5 to 9 percent slopes
21E	Lindley loam, 14 to 20 percent slopes
21F	Lindley loam, 20 to 35 percent slopes
22B	Marion silt loam, 2 to 5 percent slopes
23B	Menfro silt loam, 2 to 5 percent slopes
23C2	Menfro silt loam, 5 to 9 percent slopes, eroded
23D2	Menfro silt loam, 9 to 14 percent slopes, eroded
23E	Menfro silt loam, 14 to 20 percent slopes
23F	Menfro silt loam, 20 to 35 percent slopes
24B2	Mexico silty clay loam, 2 to 5 percent slopes, eroded
25	Moniteau silt loam
26	Putnam silt loam
27C	Sampsel silty clay loam, 5 to 9 percent slopes
27D	Sampsel silty clay loam, 9 to 14 percent slopes
28B	Smileyville silt loam, 2 to 6 percent slopes
29B	Viger loam, 2 to 5 percent slopes
30B	Weller silt loam, 2 to 5 percent slopes
31C2	Winfield silt loam, 5 to 9 percent slopes, eroded
31D2	Winfield silt loam, 9 to 14 percent slopes, eroded
32	Pits-Orthents complex

CONVENTIONAL AND SPECIAL  
SYMBOLS LEGEND

CULTURAL FEATURES

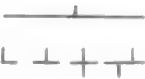
BOUNDARIES

State	
County	
Reservation (state wildlife management area)	
Neatline	

AD HOC BOUNDARY

Cemetery	
----------	--

STATE COORDINATE TICK



LAND DIVISION CORNERS  
(sections)



ROAD EMBLEMS & DESIGNATIONS

Federal	
State	
County	
DAMS	
Medium or small	

PITS

Mine or quarry	
----------------	--

MISCELLANEOUS CULTURAL FEATURES

Church	
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WATER FEATURES

DRAINAGE

Perennial, double line	
Perennial, single line	
Intermittent	
Drainage end	

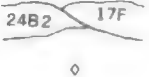
LAKES, PONDS AND RESERVOIRS

Perennial	
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SPECIAL SYMBOLS FOR  
SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

DEPRESSION OR SINK



Index Map

Welcome Page

Manuscript





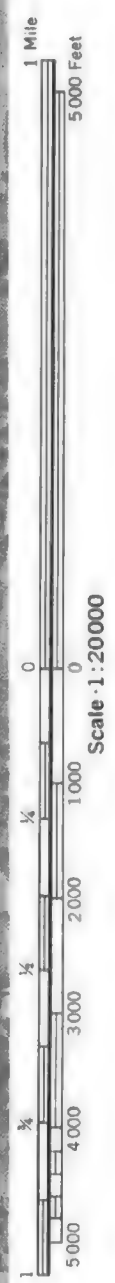






MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 3

3



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



4

MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 4



1 Mile  
5000 Feet

Scale 1:20000





MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 5



Scale 1:20000

1:20000 Feet

Join sheet 6

Join sheet 11

Join sheet 4

1 Mile

5000 Feet

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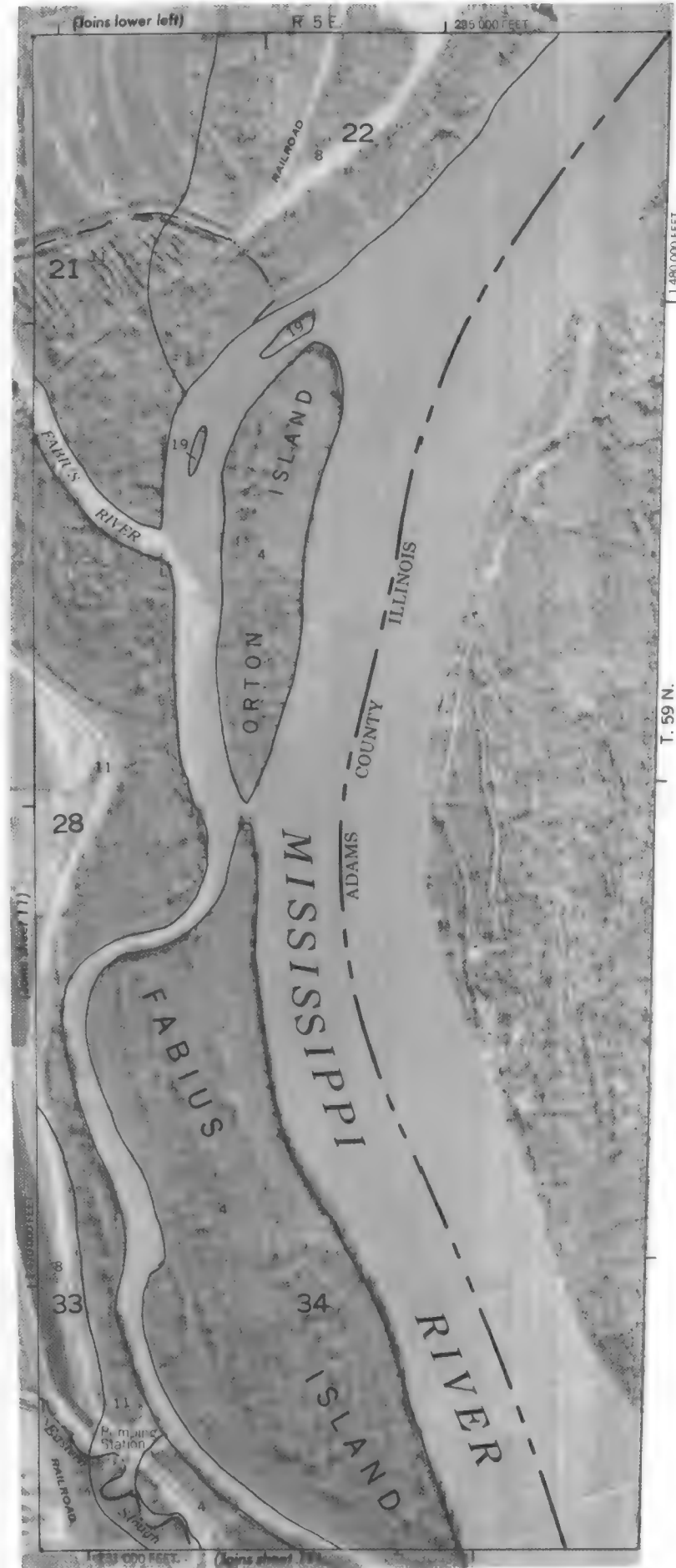
307

308</



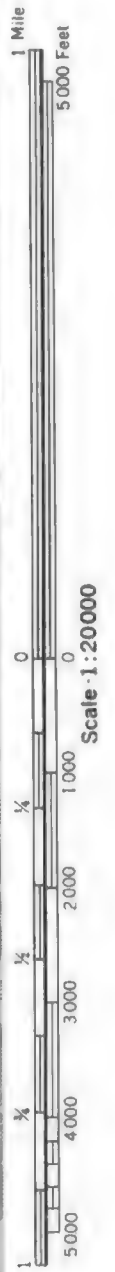
6

MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 6

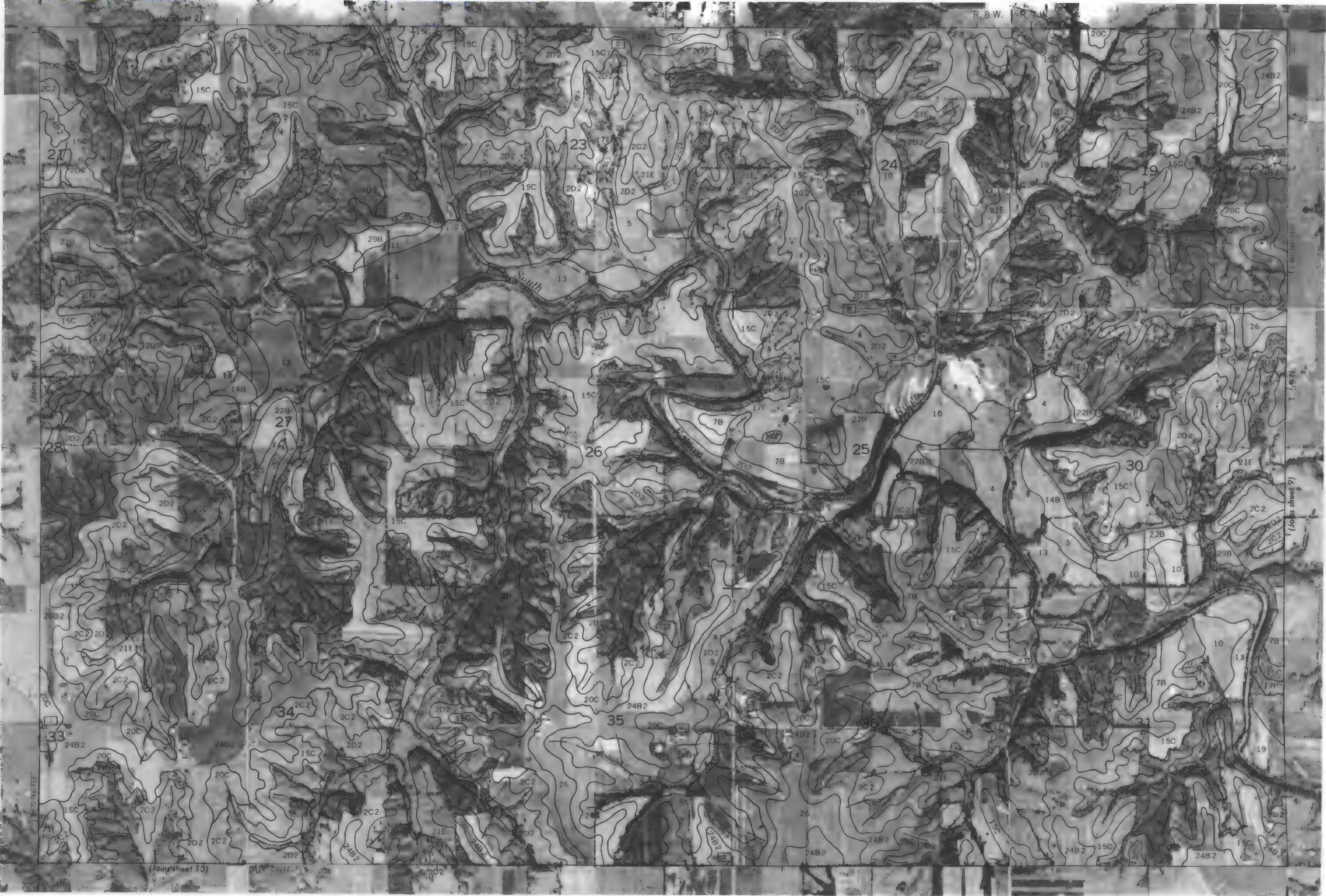
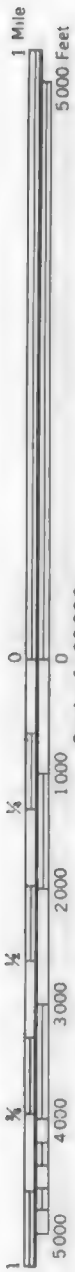


4000 AND 5000-FOOT GRID TICKS



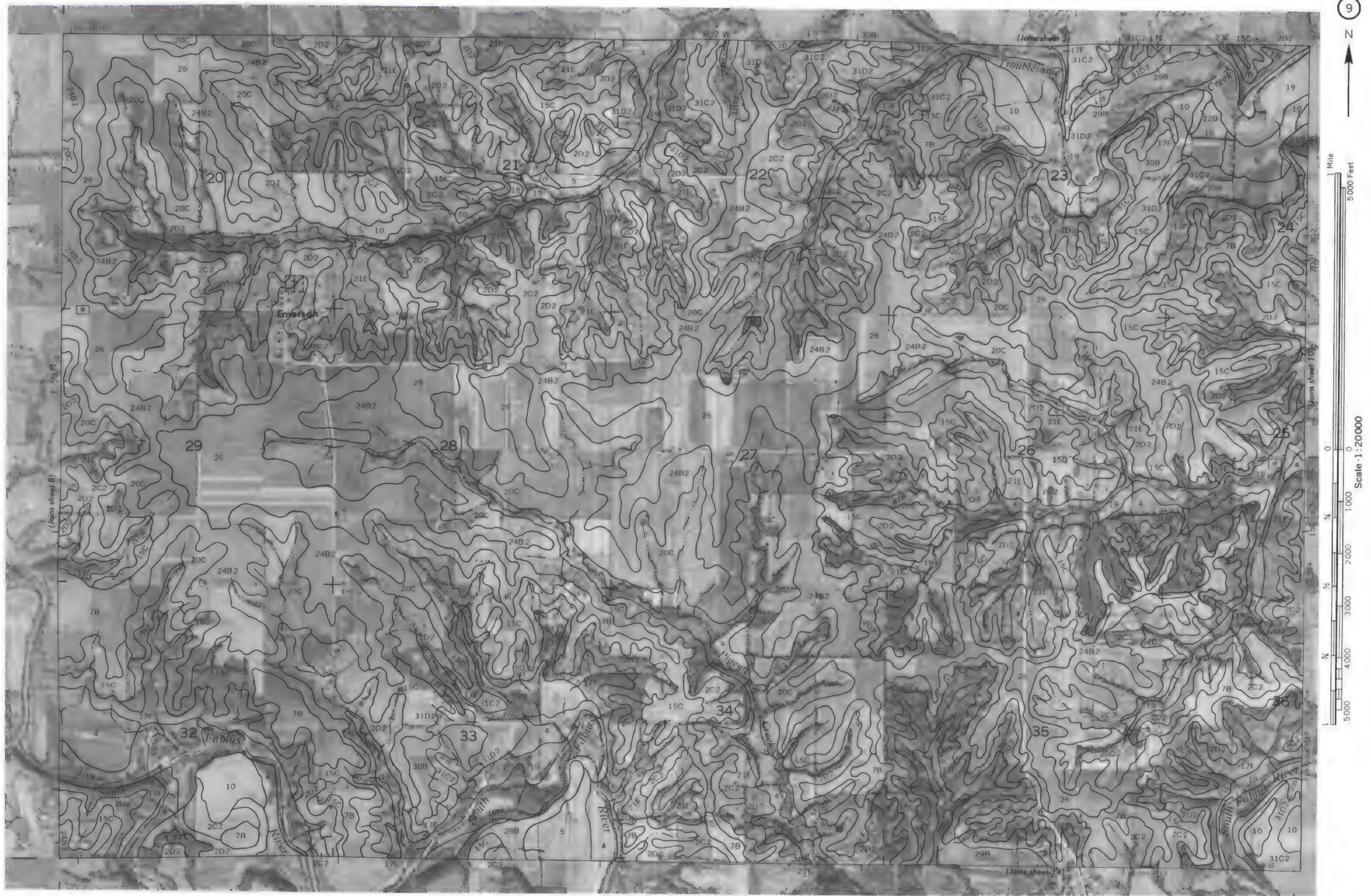






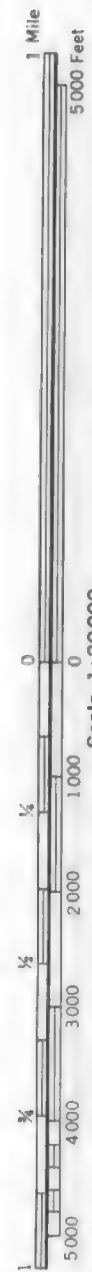


MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 9





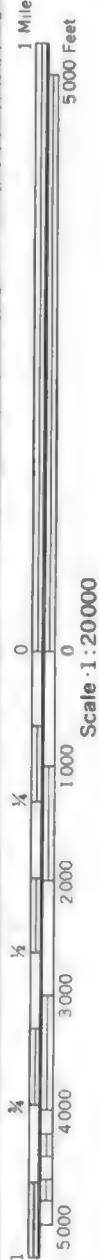
MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 10



This map is compiled from 1973 aerial photography by the U. S. Department of Agriculture Soil Conservation Service in cooperation with the Missouri Department of Conservation. Contour lines and spot elevations are shown. All other features are from the 1973 edition of the map.

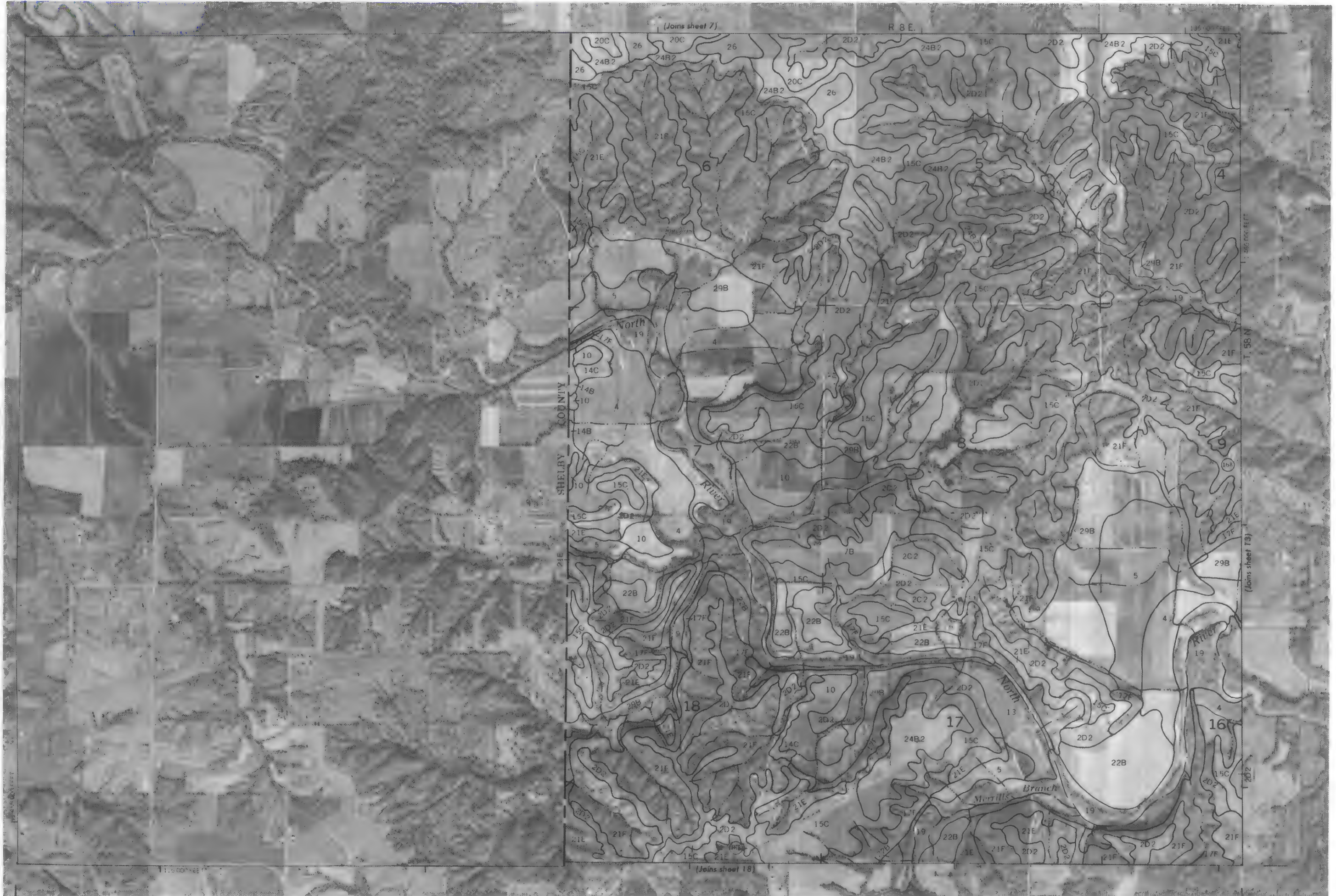
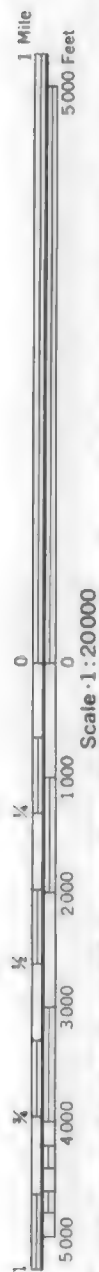


MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 11

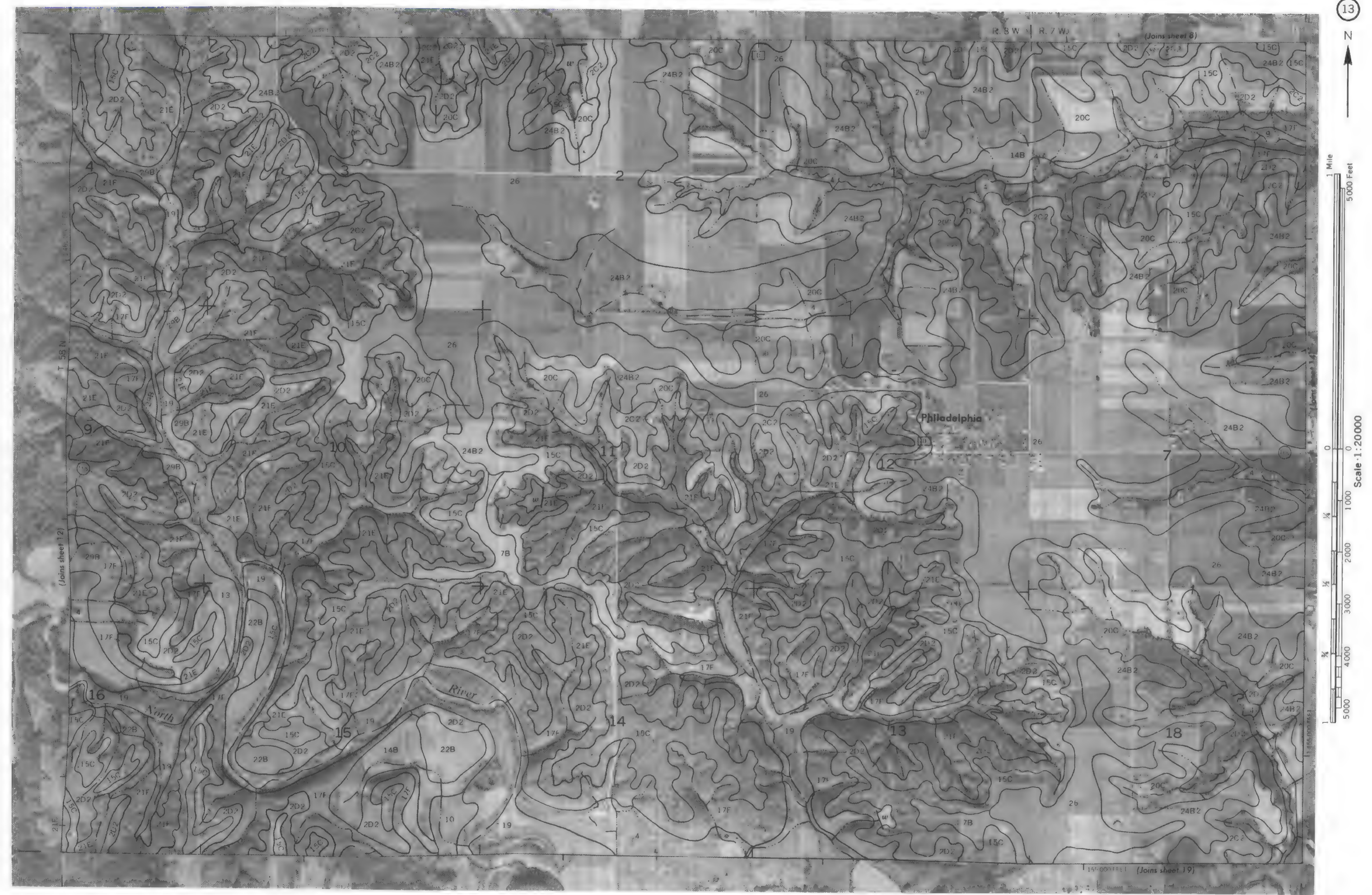


This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies. Contour lines and land ownership names, if shown, are approximately positioned.









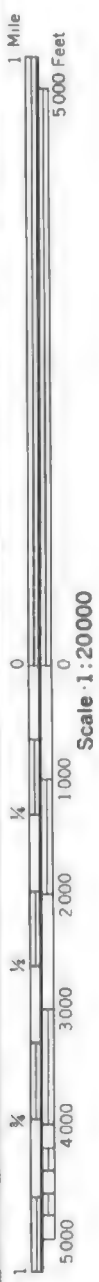
This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Contour lines and spot elevations are approximately positioned.







MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 15

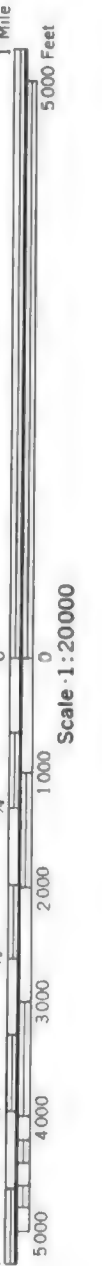


Scale 1:20000







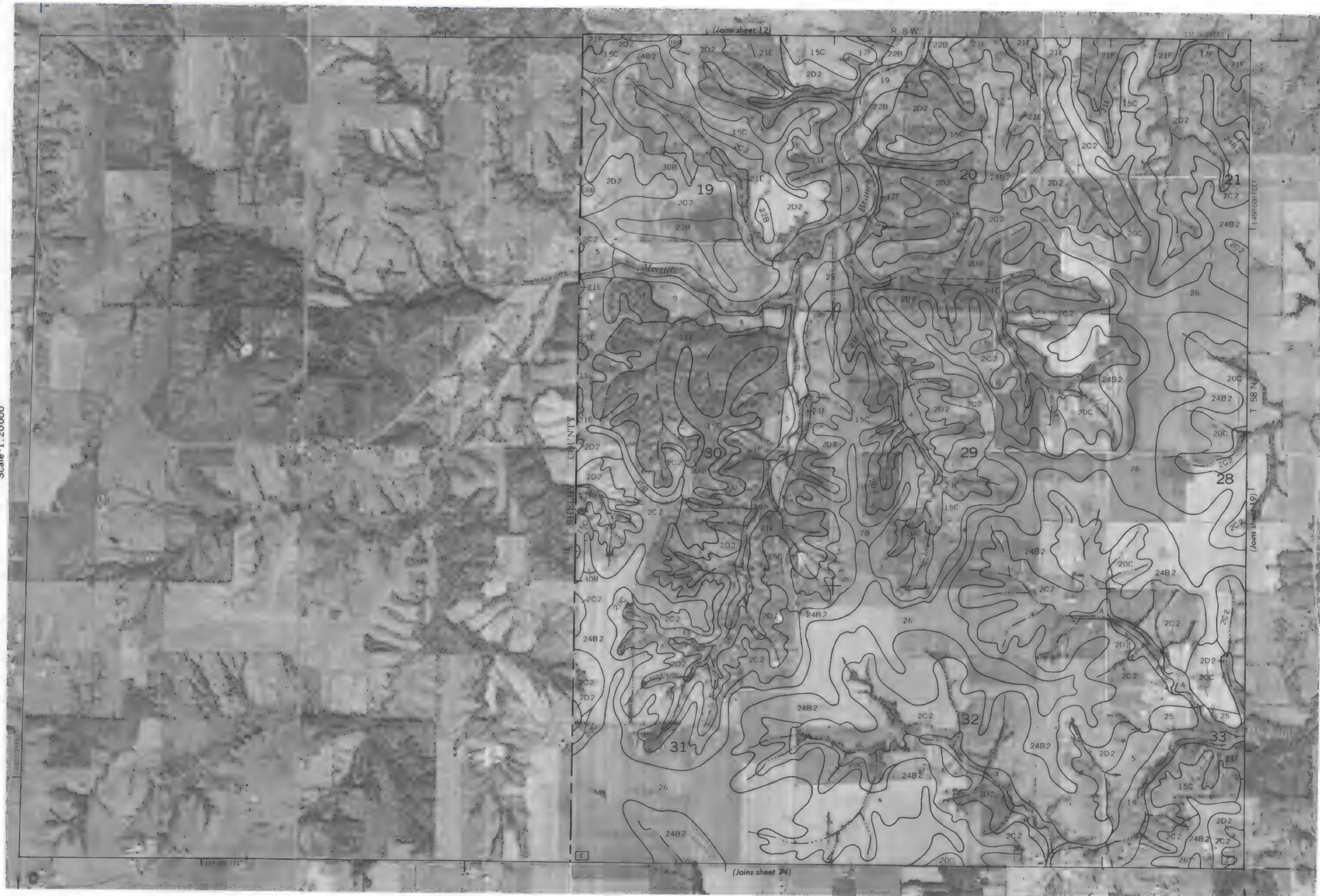






1 Mile  
5000 Feet

Scale 1:20000

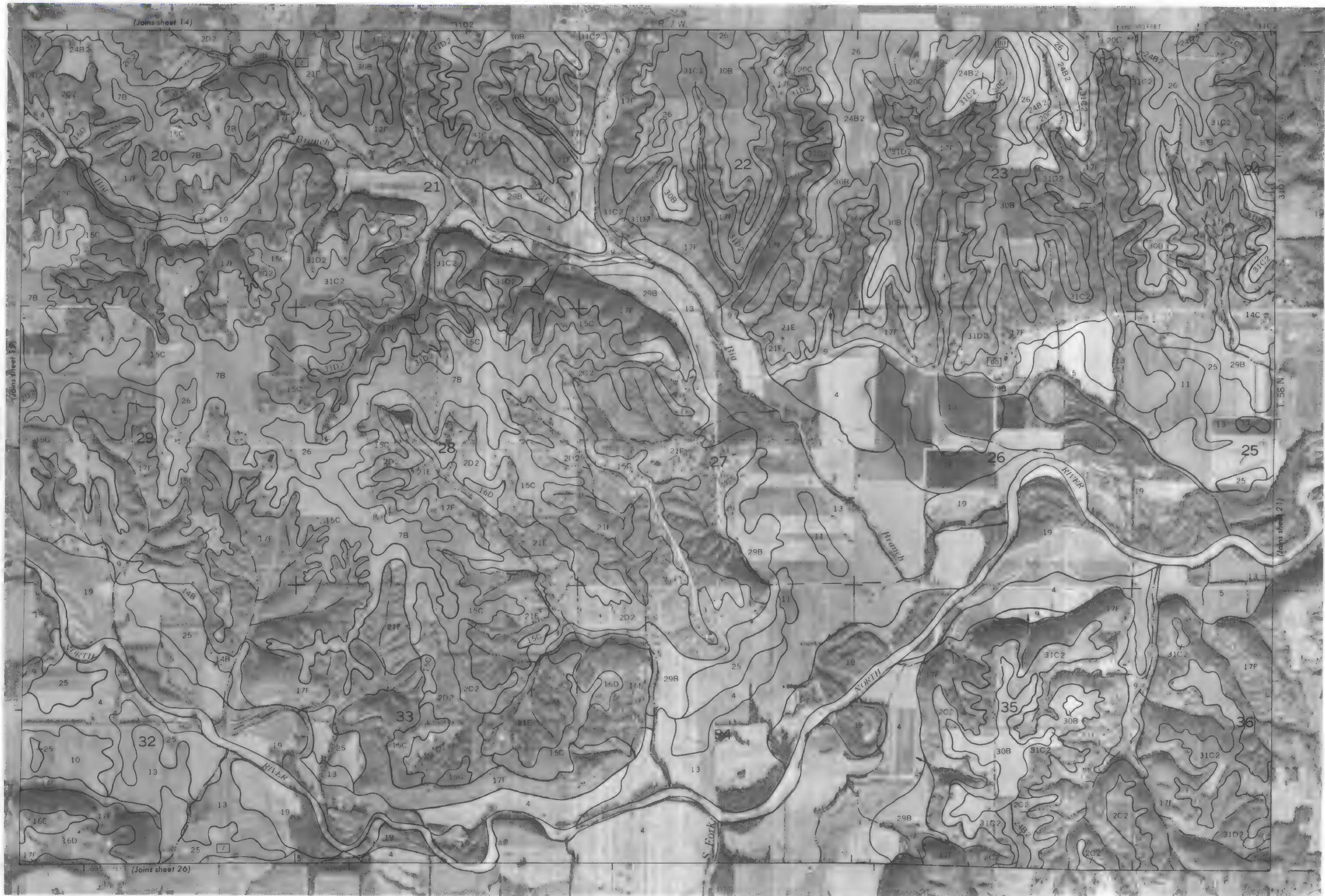
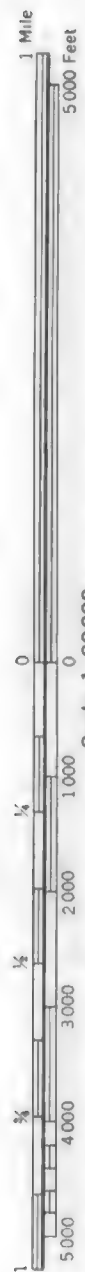








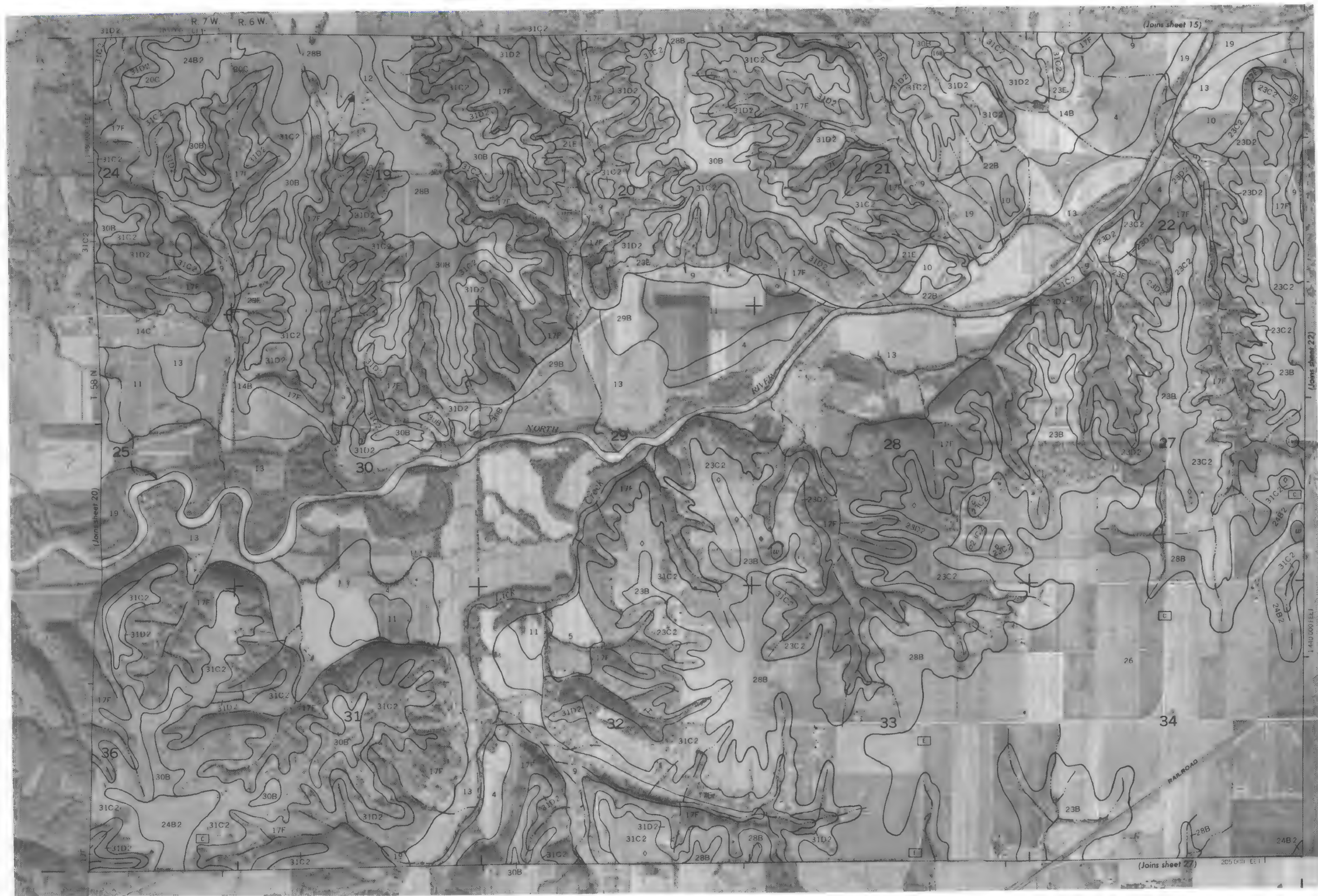
MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 20



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 21







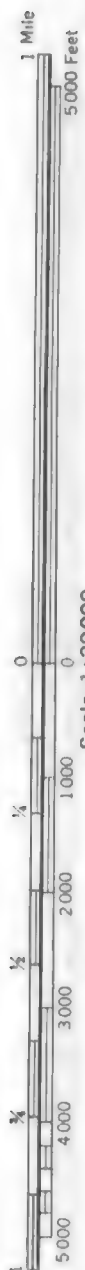


MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 23



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positions.







MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 25

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Contour and spot elevations and land division corners, if shown, are approximately positioned.

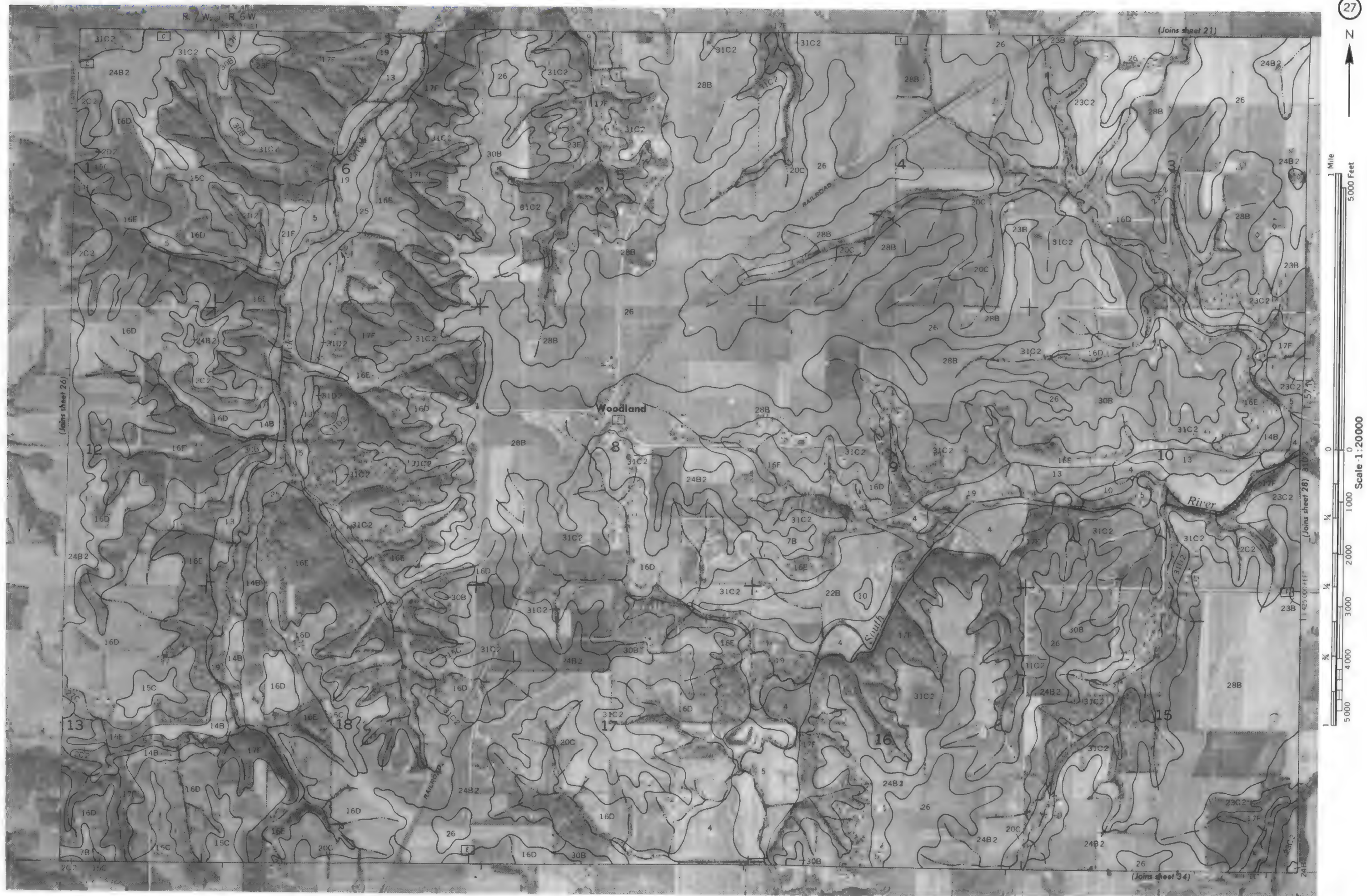






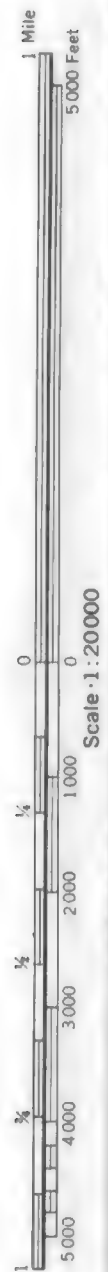


MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 27





28





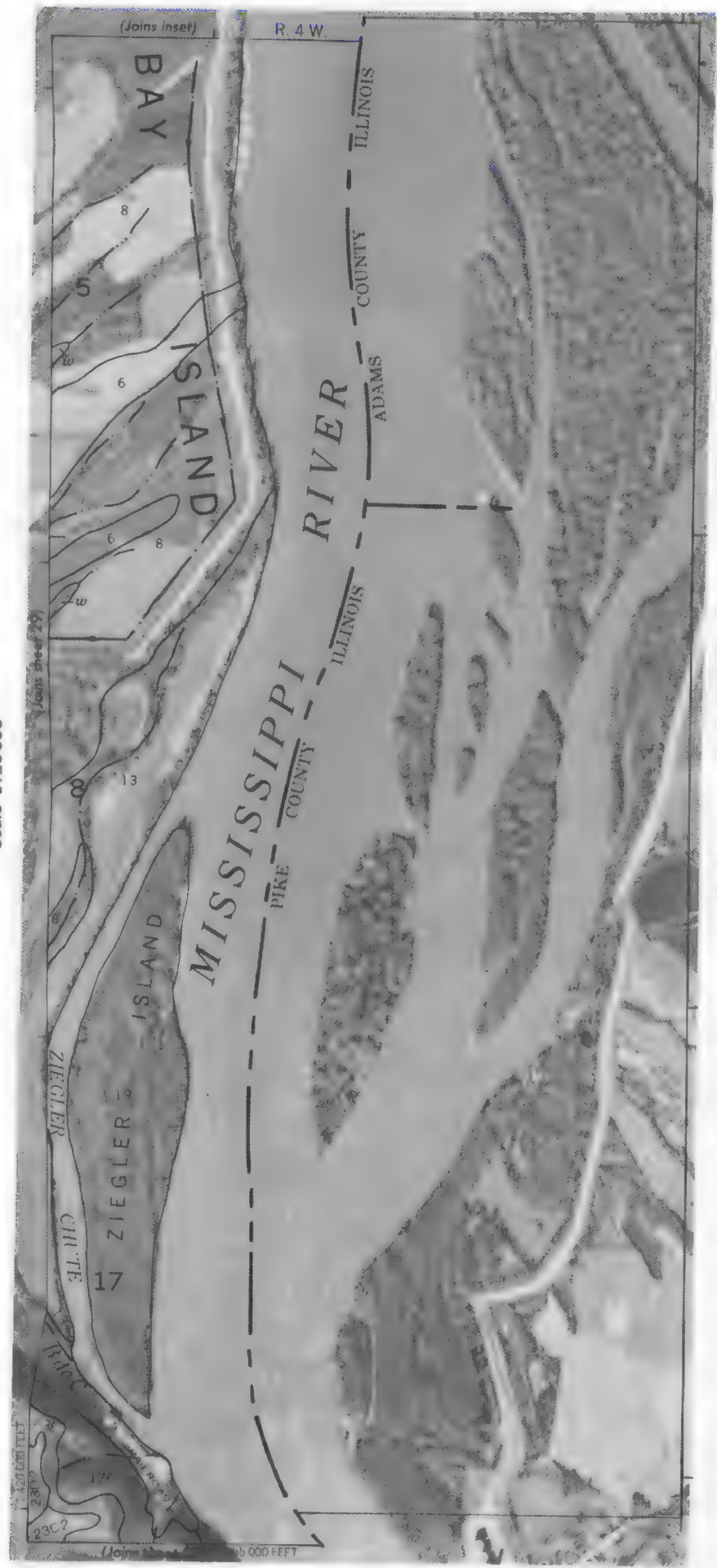
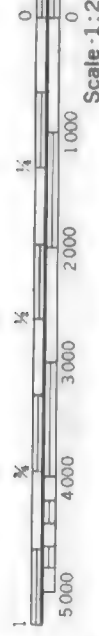






1 Mile  
5000 Feet

Scale 1:20000





MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 31





MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 32

32



1 Mile  
5000 Feet

Scale 1:20000







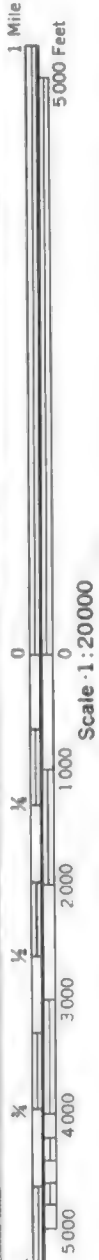






MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 35

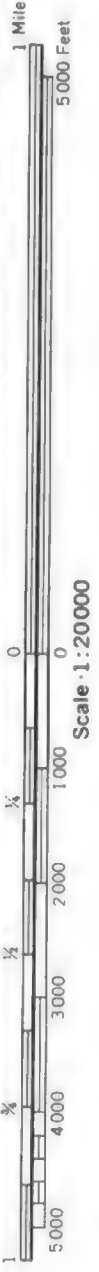
Coordinate grid ticks and section divider corners if shown are approximately positioned





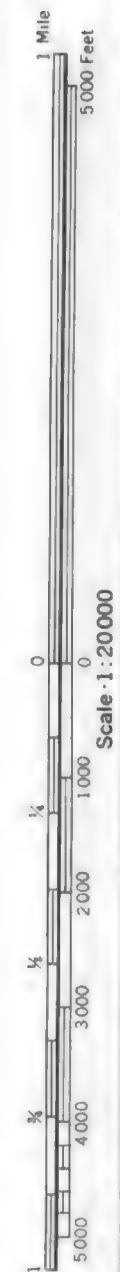






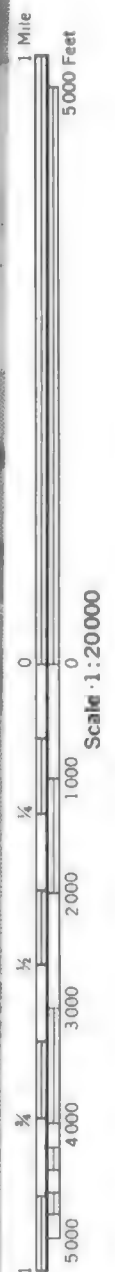
Scale 1:20000







This map is a reproduction of the original map. It is not a survey. It is not a legal document. It is not a substitute for a survey. It is not a substitute for a legal document. It is not a substitute for a survey. It is not a substitute for a legal document.



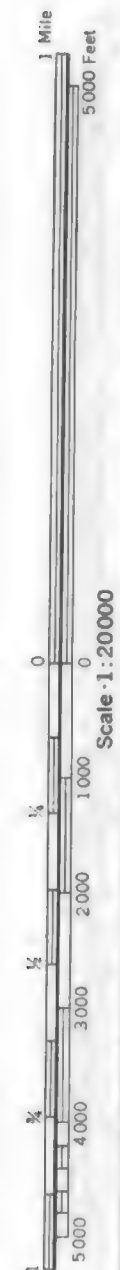














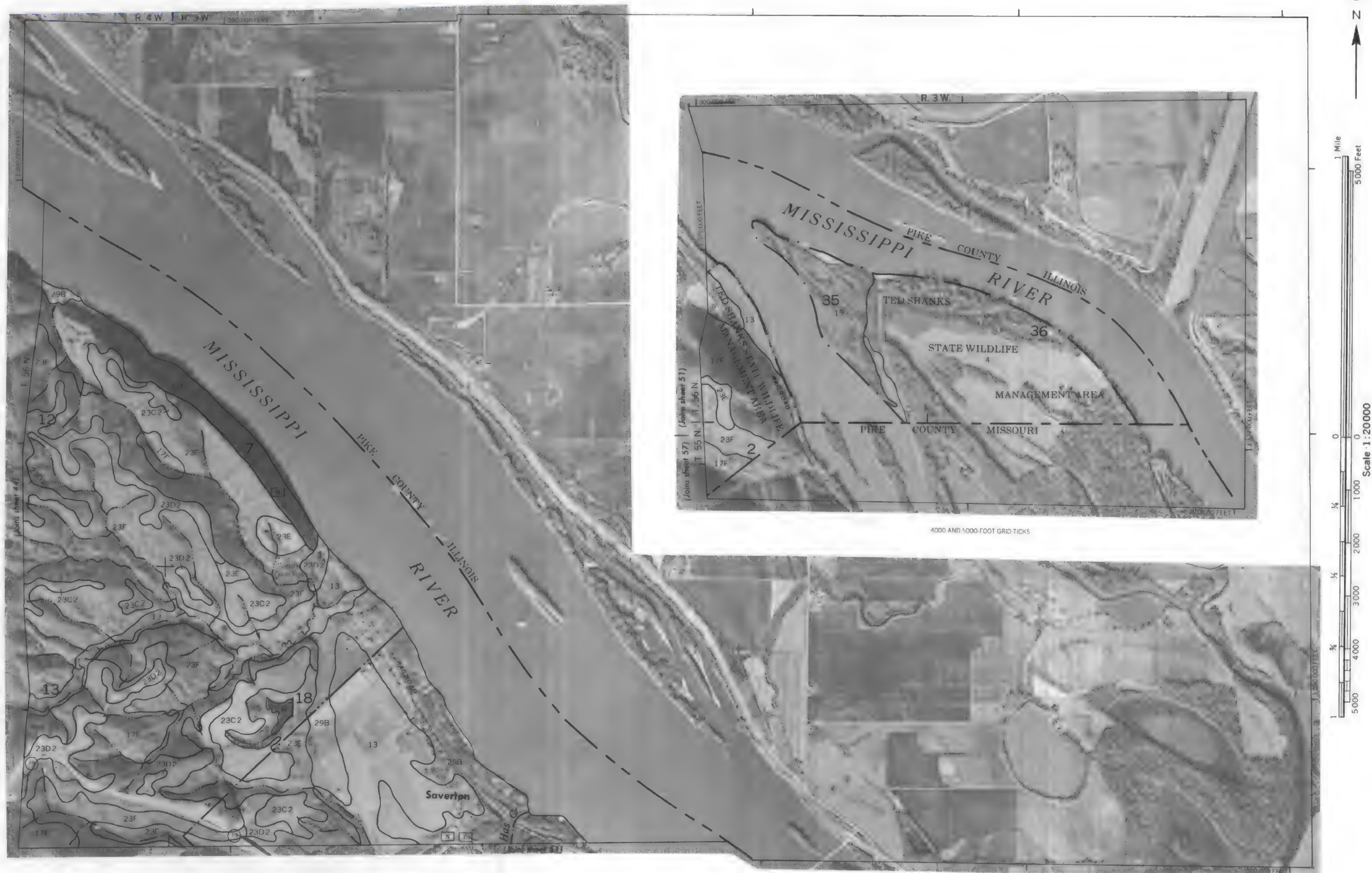


This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies. Contour interval is 10 feet. Elevation is in feet above sea level. Shaded areas are swamps. Shaded areas are swamps. Shaded areas are swamps.





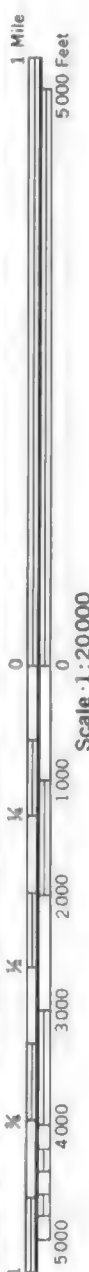










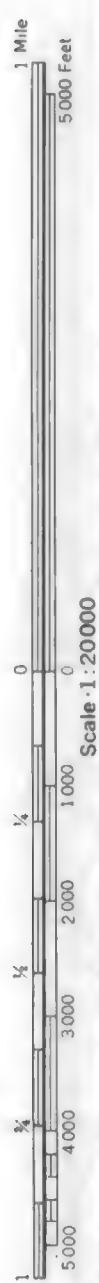


This map is compiled from 1912 aerial photographs by the U.S. Geological Survey. It is based on the original maps and is not a reproduction of the original maps. The map is not a reproduction of the original maps and is not a reproduction of the original maps. The map is not a reproduction of the original maps and is not a reproduction of the original maps.



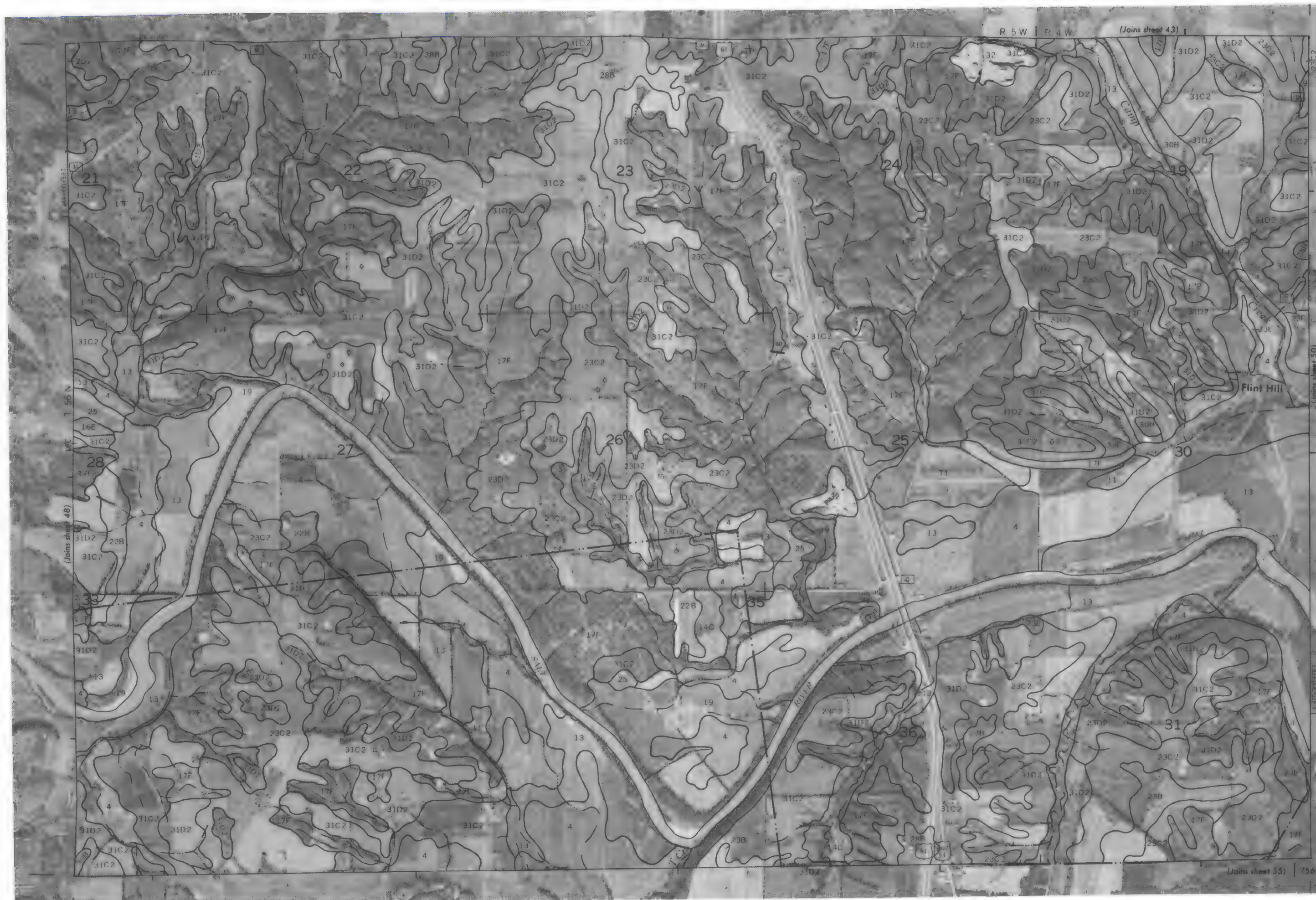
MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 48

48

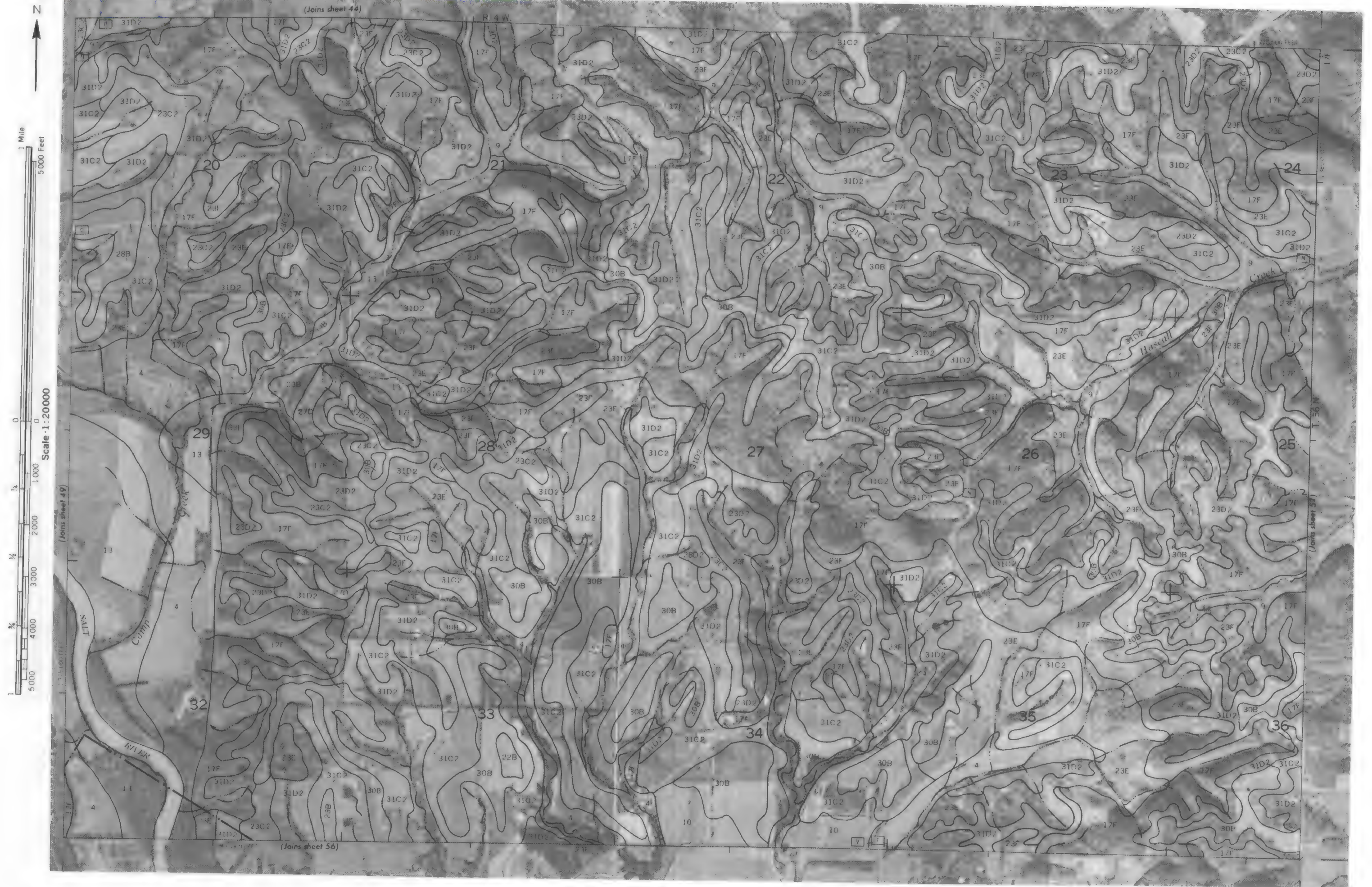


This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

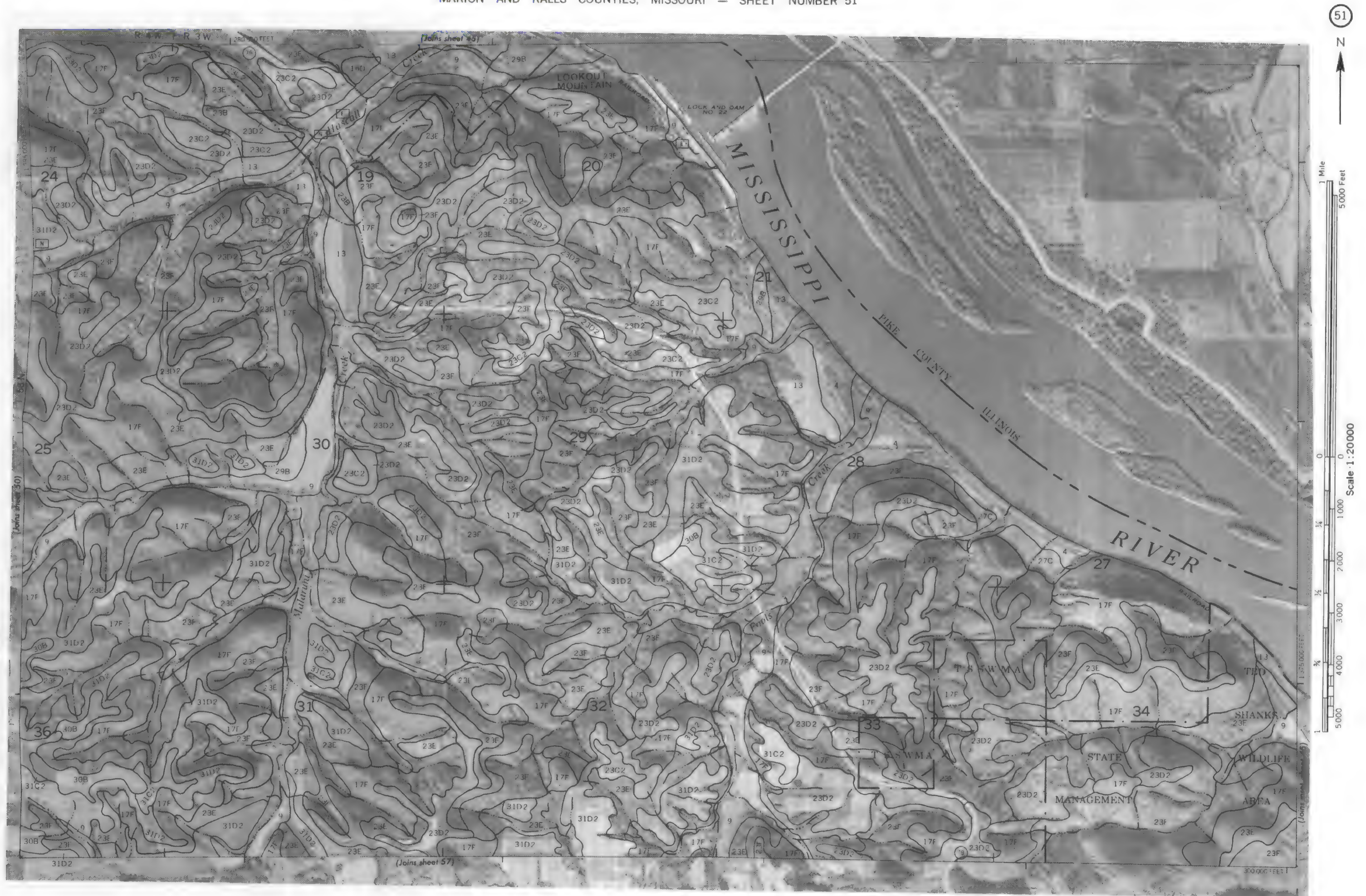










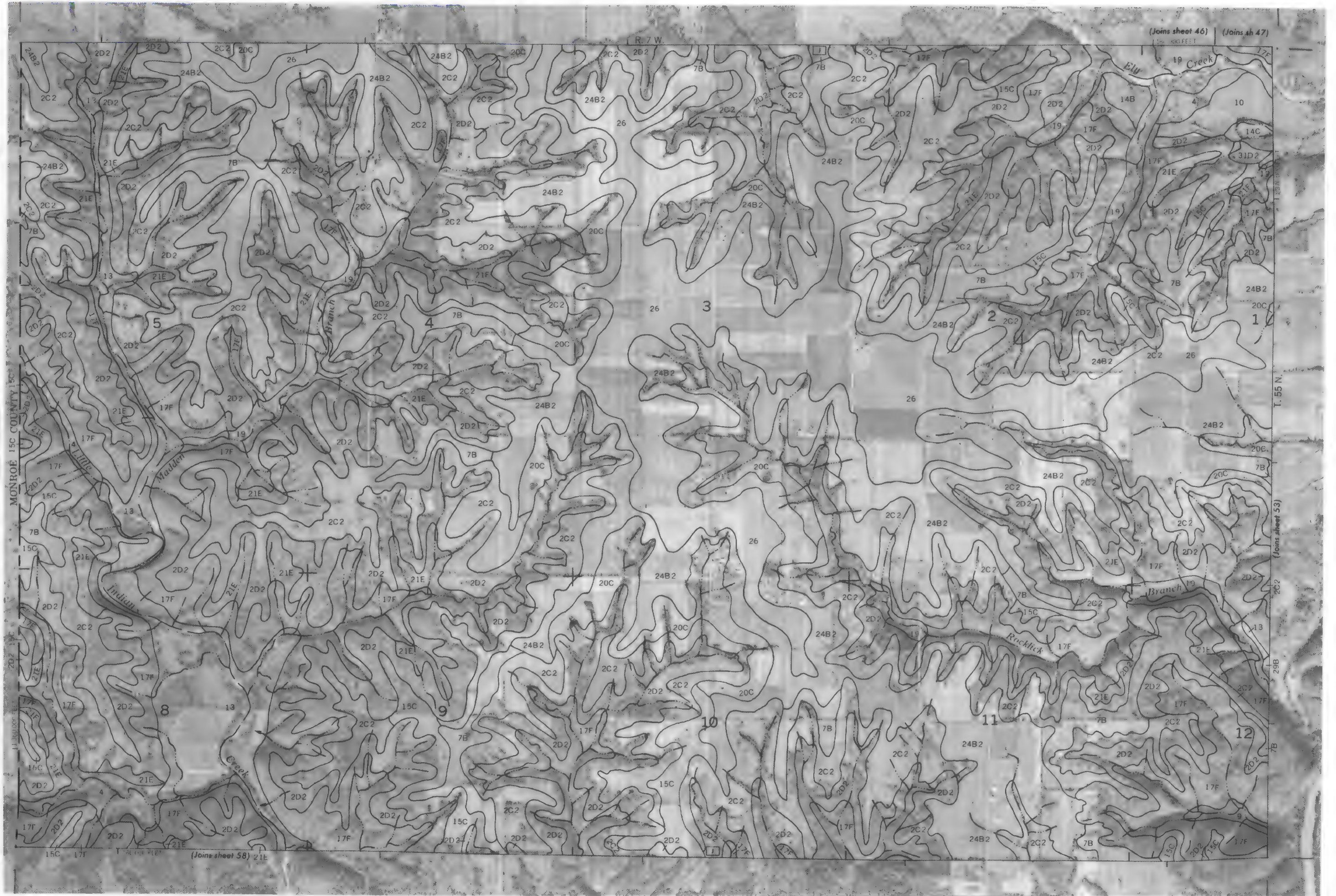




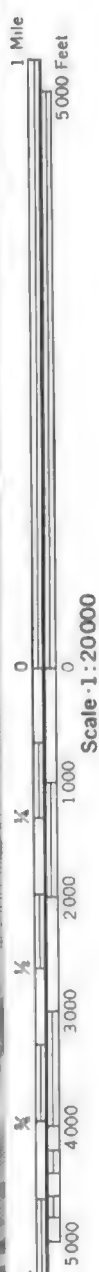


1 Mile  
5000 Feet

Scale 1:20000





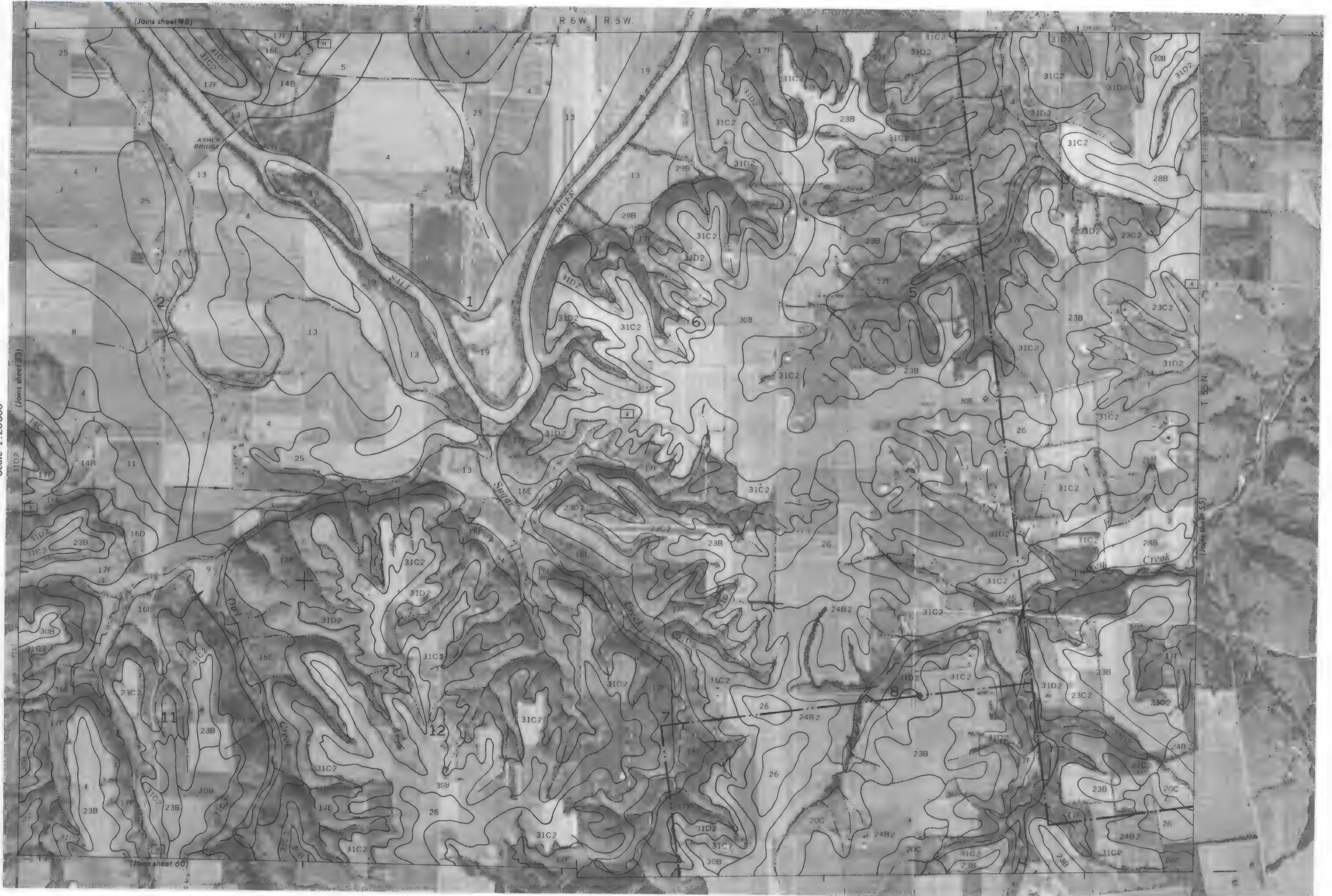
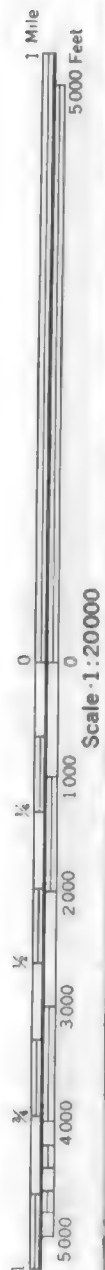




54



MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 54











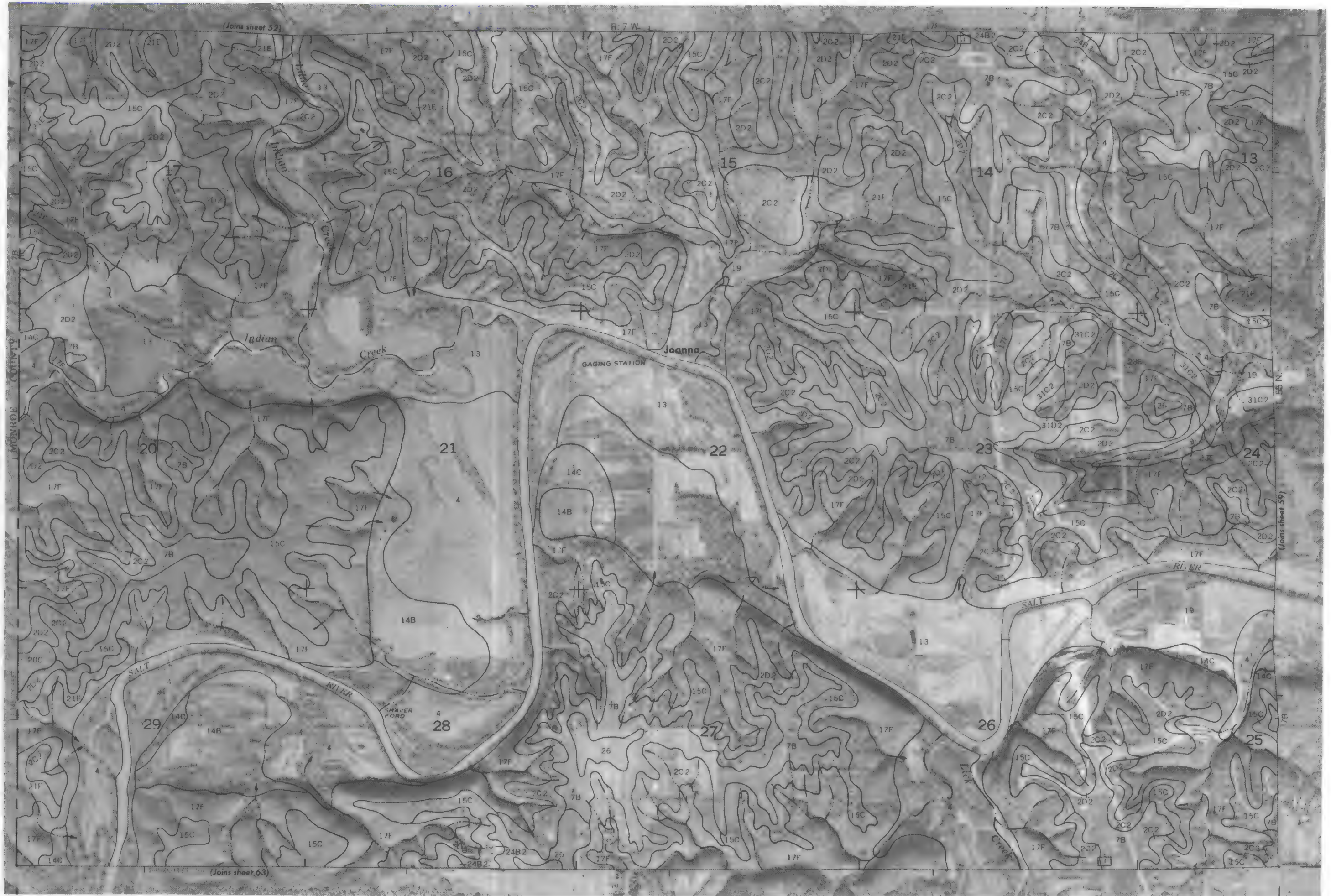
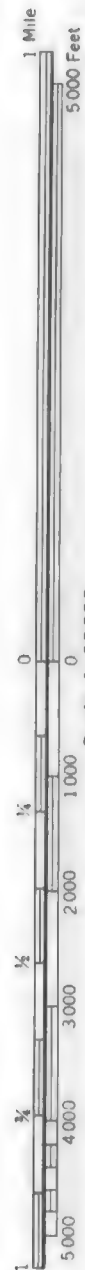
This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Contour lines and labels are approximate. Coordinates are approximate.





This map is compiled on 357 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinates and ticks and land division centers, if shown, are approximately positioned.

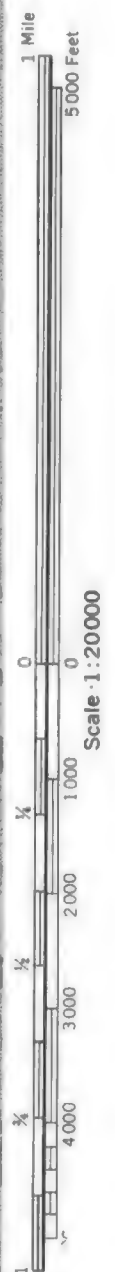






MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 59

59



The map is compiled on 1971 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperative agencies. Coordinate grid ticks and land division corners, if shown, are approximate in position.



60

MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 60





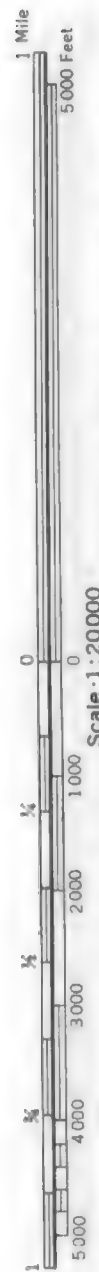
MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 61





MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 62

62

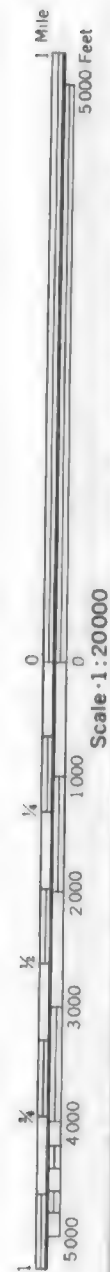




MARION AND RALLS COUNTIES, MISSOURI -- SHEET NUMBER 63









## MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 65







1 Mile  
5000 Feet

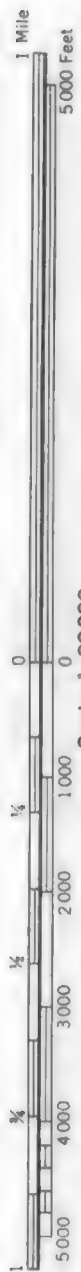
Scale 1:20000













MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 69





MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 70

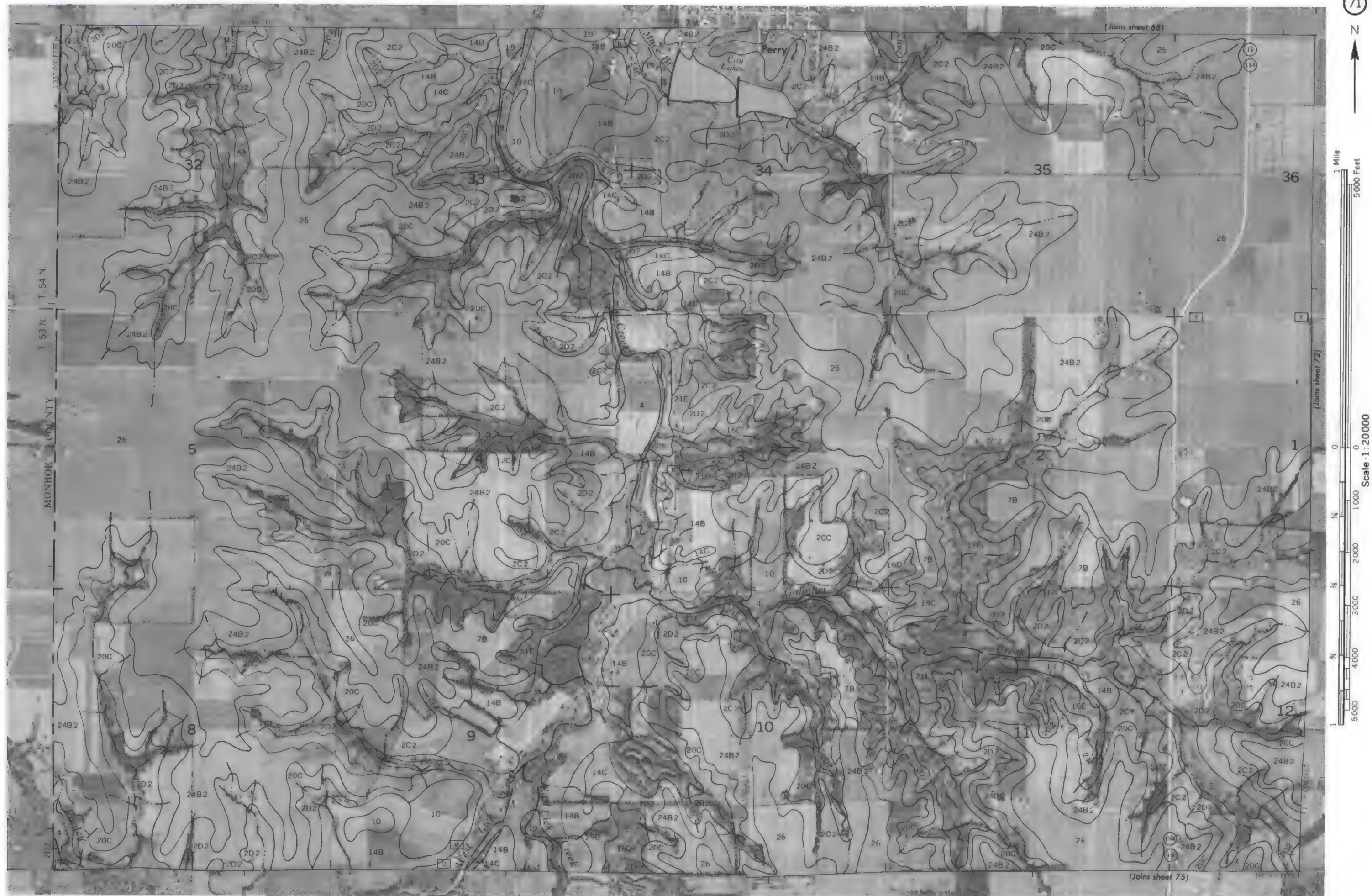
70



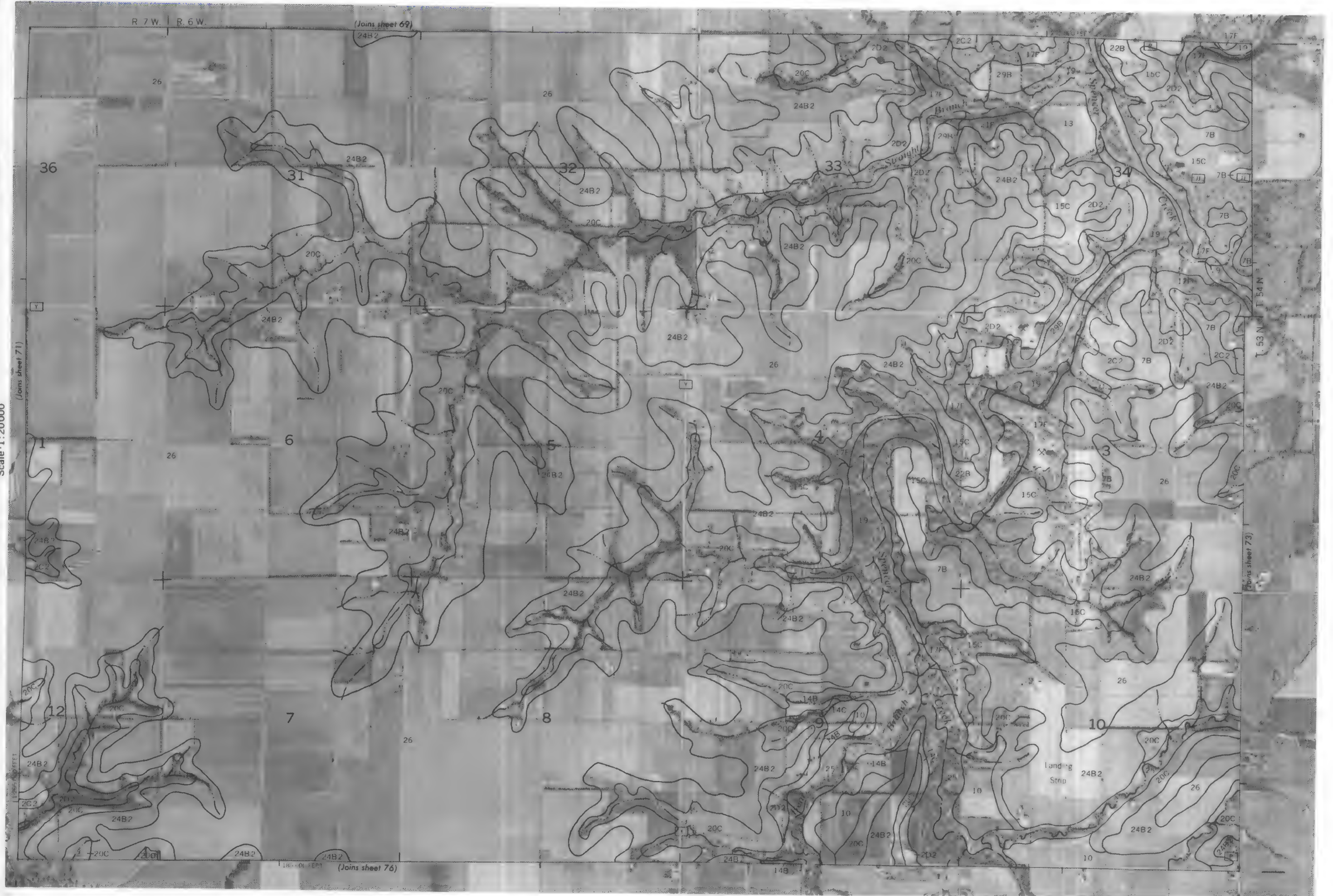
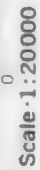
This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



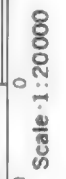
MARION AND RALLS COUNTIES, MISSOURI — SHEET NUMBER 71









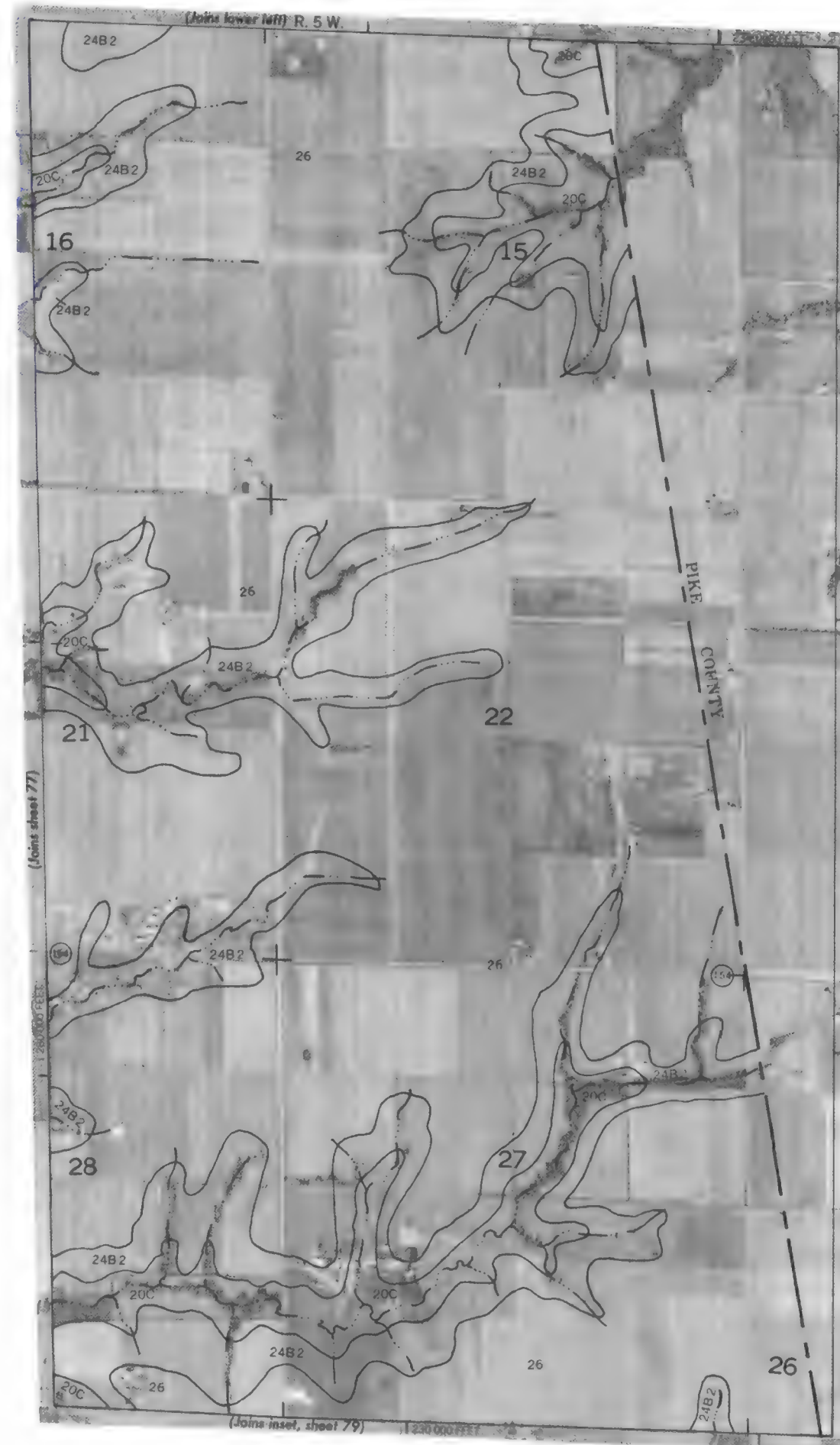
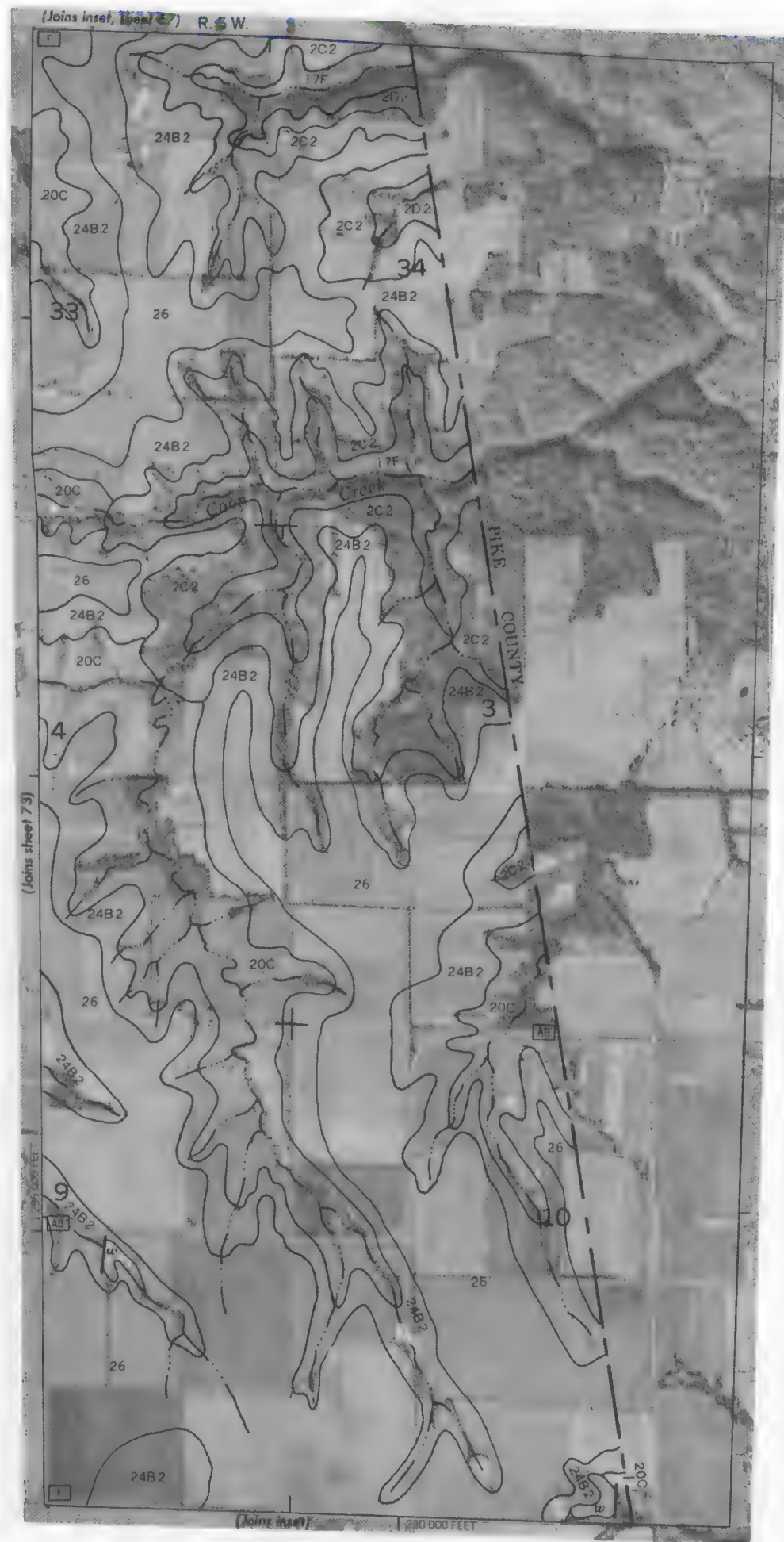






1 Mile  
5000 Feet

Scale 1:20000









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